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THE METHODS OF THE NATURALIST AND PSYCHOLOGIST.

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I.

Section 1. — Attention has often been called to the mutual advantage that accrues to apparently diverse sciences when they come into close touch, and this has been illustrated lately by one of our members by reference to the contact of psychology and medicine. What such Doctors of Medicine as Lotze, and Müller, and Wundt, and our own James, have done for psychology, when they turned their attention to it, is patent. And that an equally momentous counter-influence upon medical science has resulted from its contact with psychology is evident in our modern psycho-pathological methods.

The modern correlation of natural science and psychology must in like manner be of advantage to each. That the work of the naturalists has served to broaden our psychological conceptions we are all indeed ready to acknowledge. How far their contact with the psychologists has benefited, or is to benefit, the naturalists we may modestly decline to consider, awaiting however with confidence the acknowledgments which will properly come from them.

And in this connection it may be remarked that no little significance is to be attached to the fact that the American Psychological Association has chosen this year to meet here in affiliation

with the American Association of Naturalists rather than with the American Philosophical Association at Cornell. No one will deny that the relation between psychology and philosophy is properly held to be a very close one; and the choice made by this association therefore indicates a marked eagerness on our part to strengthen the bond of alliance which already exists between ourselves and the naturalists. An outsider might well say that we are off with our old love and on with a new; and might furthermore observe that we have appeared as the suitors in this alliance, and that the naturalists have been somewhat hesitant in reaching the opinion that we are worthy of their regard; which has finally been compelled, I take it, by the evident scientific ability of certain of our members, and by an assurance that we have become devoted to the experimental method.

Section 2.—This promise of devotion to experiment, I am inclined to believe, has been interpreted to carry with it by implication a further determination to abjure the method of introspection which the naturalists as a body have held in contempt; and I am wondering whether they will not repent of their acceptance of us as suitors when they note that you have elected as your president this year a man who has never been influential in the foundation of a psychological laboratory, and who has never published statistical records of experiments involving the use of mechanical apparatus. I thus find myself impelled at the outset to assume the rôle of the apologist, lest the affection of the naturalists be cooled by the fact that I am called upon to represent the psychologists upon this occasion.

With this end in view I would ask the naturalists to note that we are not without claims to their recognition other than those just mentioned. It is true that our eagerness to have our names coupled with theirs has been due to our recognition of the illumination we have gained from the study of their work; but on the other hand I am inclined to believe that they themselves have been led to accept us as suitors partly because they dimly realize that many of their number are in the habit of using psychological data constantly as aids in the interpretations of many of the facts with which they are called upon to deal.

It is clear for instance that no merely objective study of the

retina could have led a student of optics to surmise that its tissues, in which the rod and cone arrangement is most prominent, could have such functions as are attributed to them by modern optical theorists. Only because introspective observation shows us that light waves produce in us an enormous differentiation of shades and qualities of color have our students of optical physiology been led to look for corresponding differentiations of functioning in the retina and its connected parts.

But I wish to go beyond this, and with some boldness to ask the naturalists whether they have ever had just ground for their all but contemptuous attitude towards the psychology of pure introspection. I would ask them if they realize that each step they and all other devotees of science take in their work is in the end based upon this introspection. When the chemist arranges a crucial experiment, and when he devises his mode of procedure, is he not concerned altogether with processes of thought? And thought processes cannot be developed apart from introspection. And when he notes the reactions resulting from his experiment is he not dependent upon the observation of the color of the product or of its weight perhaps; and is not his judgment finally determined by a discrimination of his color sensations, and by the accuracy of his perception of the movements of the scales in which he weighs; and are not these sensational and perceptual discriminations well marked cases of pure introspection?

My illustration has been taken from one of the physical sciences but I think we must grant it to be true of all the naturalists', as indeed of all scientific experiments, that introspection is their final determinant; and therefore that the attitude of the naturalist towards those who devote themselves to the analysis of the laws of this introspection should be one bordering upon humility rather than one of condescension and self-confidence.

What can be more important to science at the present moment than the determination of the basis of certitude — of our conviction that certain facts are real. Yet this problem relates to the appreciation of realness with which is inextricably bound up our experience of belief: and surely it must be

agreed that we can only study this problem profitably by a purely introspective examination of the relation of the sense of realness to the rest of conscious experience.

But I hear some naturalist say "Well suppose we grant that introspection has an indirect relation to our work, or follow you further and grant that it is the final instrument of service of all scientists, the question we raise is whether it has any practical value unless you adopt in connection with it the special methods of experiment which have been devised by scientific workers apart from all thought of psychology?" And this question leads me to ask you to turn for a moment to enquire as to the nature of this method of experiment, and as to its value.

II.

Section 3. — I take it that the method of experiment consists in nothing more recondite than the attempt to determine whether observed objects are really of the nature usually ascribed to them; this being accomplished by tests which enable us to discriminate the appearance from the reality.

And here I would ask our naturalist to note that the objects which he observes are of many and various types, and that his 'objects in the outer world' are not the only form of objects. In his description of them as objects 'in the outer world' he implicitly acknowledges, what we psychologists explicitly claim, the existence of other objects than these natural objects, viz., objects of attention. And then I would ask him to note further that all his 'objects in the outer world' are also objects of attention, so that it would appear that his material objects are but a special class of those objects which the introspective psychologist studies.

And then we are led to ask what ground there is for the assumption that the method of experiment is applicable only to objects in the outer world — whether we are not nearer the truth if we hold that this method is equally applicable to all objects of attention, in which case it must be applicable within those fields of pure introspection which involve no consideration of outer world objects.

And this I take it must be conceded to be true. We may

take as an instance of such use of the experimental method Professor Woodworth's very valuable studies in relation to imageless thought. It being generally assumed that thoughts are always made up of 'image stuff,' if we may so speak, he as you will recall has devised tests, of a purely introspective type, which seem to show conclusively that this common view is untenable. I do not see how any one can deny that he has employed the method of experiment; yet he has dealt altogether with introspective data.

It is perhaps to be granted that we have neglected in the past the method of experiment in introspective psychology, but it seems to me to be the greatest of mistakes to hold that this method is inapplicable except where laboratory machinery can be used, and an equally grievous error to assume that introspective psychology is in itself relatively unimportant.

And in this connection I would especially make a plea for a return to the careful analysis of pure introspection. We must grant that psychology made its most important advances before the thinking man was at all cognizant of the nature of the nervous system, and of the correspondence between its activities and changes in the nature of consciousness with which our psychophysicists concern themselves. And these advances were due to introspective study which I believe will still yield to us precious fruit if we are guided by our conviction that this analysis to be of final value must be tested by experimental procedure.

Section 4. — I thus oppose the view, which I fear we must say is not uncommonly held to-day, that psychology is of little importance unless it makes use of methods which involve the use of laboratory machinery. And with especial relation to the modes of work in these laboratories I wish to turn for a moment to the consideration of certain points in relation to the acknowledged value of the experimental method.

In the first place I may speak of a value of lesser importance; I refer to the value of the experimental method as a discipline, as a mode of training which enables us to acquire the habit of dealing, if we may so speak, not with things as they appear but with things as they are. It is this value that is of the highest importance pedagogically.

In this connection I must run the risk of being thought to undervalue the work that is being done in our psychophysical laboratories when I confess that I think we tend to overestimate its importance to the student as a mode of discipline in observational accuracy, and that oftentimes more valuable results to the student in this same direction would be obtained by careful work in physical or chemical or physiological laboratories; and this without leading him to gain false conceptions as to the real nature of psychology to which I shall presently refer.

And here I would ask you to note that a large part of the work done in our psychophysical laboratories consists really of experiments in neurophysiology in which the tests are so clearly of an introspective nature that the fact cannot be masked; and that from our point of view they differ from what are known as strictly physiological or neurological experiments mainly in the fact that in these latter the final dependence upon introspection is overlooked and unacknowledged. I am indeed sometimes inclined to think it a misfortune that we have come to speak of such work as experimenal psychology at all, and have not rather described it as a special branch of neuro-physiology. For I am convinced that we often give the immature student an utterly false view of the nature of psychology by our modern emphasis of this so-called 'new psychology'; for he is in my experience very often thus led to believe that the only really valuable psychological work is that done in the psychophysical laboratory. And if once he gains this impression he is easily led to think of his mental life in terms of mere mechanical formula, and as the result of this to gain materialistic conceptions which are entirely unwarranted.

Section 5.—Clearly the main value of the experimental method lies in the fact that it occasionally enables the investigator to discover the hidden nature of the objects with which he experiments.

But we become so interested in the methods and machinery used in these experiments that we are too prone to forget that they are but means to an end. As a bit of evidence in this connection let me quote from a late number of the *Journal of Philosophy* where an important writer uses these words: "At the

physiological congress only two papers of special interest to experimental psychologists were presented. *These are papers dealing with methods rather than results, and are therefore more valuable.*"[1] I may add that one of the papers thus referred to described a newly constructed room for sound experiments; the other the use of an instrument for testing retinal excitability.

In this connection I may be frank again in another direction in saying that I am inclined to think we have allowed ourselves, and have encouraged the young student, to give too much attention to the mere collection of observational data as though there were some special value in this collecting for its own sake. Certainly there is no virtue in the gathering together and tabulation of such observational data unless we are led thereby to throw new light upon the psychological problems presented to us, and I submit that such collection and tabulation is usually valueless unless it is undertaken with the definite purpose of testing some specific problem or hypothesis which we have in mind.

If the criticisms to which you have listened have seemed to some of you to be too sweeping I shall ask you to believe that I have spoken purposely of things at their worst, and that I do not fail to appreciate the full value of the conscientious and valuable effort of the laboratory workers numbered among our members; who perhaps may find their feelings of enmity toward me somewhat softened if I open fire especially upon the introspective psychologists; and I shall therefore ask you to consider for a moment what seems to me to be a very fundamental defect of method in their procedure.

III.

Section 6. — If we look back at the history of any science we discover that in its crude beginnings those interested in it were content to deal with the striking facts related to their subject that naturally attracted their attention; and devoted themselves to attempts to coördinate all facts of less prominence with those which were thus most emphasized. On the other hand each science as it has developed has taken a second step which has led to immensely important advances; it has deliberately turned

[1] Italics mine.

its attention away from these most prominent characteristics, and has concerned itself with the discovery of what is fundamental, treating all noticeable characteristics, whether prominent or not, as exemplification of laws of deeper significance.

In botany for instance the classification of plants was first made by reference to their most easily noticeable characteristics. They were classed by reference to the forms of fruits by Andrea Cæsalpinus in the sixteenth century, by reference to their woody or herbaceous nature by Morison in the seventeenth century, by reference to the forms of the flowers by Rivinus and his followers in the eighteenth century, by reference mainly to sexual characteristics by the great Linnæus. These classifications are in our time looked upon as of minor importance, the botanists of our day giving themselves to the study of affinities based upon fundamental morphological, structural, and physiological characteristics.

So the histories of the olden times were records of startling events — the crowning of kings and emperors, the battles lost and won, the treaties made. But in our day history is laying aside its narrative and its didactic forms, and is becoming a study of what Freeman called continuity, and what Robinson is calling a continuity of process, which brings the past into direct relation with our own life of the present.

Section 7. — Now it seems to me that introspective psychology can scarcely claim to have taken many steps in its development beyond this first crude stage above referred to, in which it has taken cognizance of the most emphatic types of experience and has attempted to arrange all else of experience in relation to these emphatic forms.

Our sensations are clearly the most marked forms of experience, and the sensationalists of old, and of our day, have aimed, and are still aiming, to explain all mental phenomena upon the presupposition that they are sensational in their nature. Even the associationists, who concerned themselves with the study of images and their relations, began by treating them as sensational combinations which are merely so 'washed out' that their vividness and liveliness is lacking. And in passing I may remark that I know of no better example of an attempt to base a sci-

ence upon an unverified and, in my view, utterly unwarranted assumption.

And in our own day I cannot but feel that we are in danger of giving valuable time to a similar crude scientific method in the attempt to make our motor presentations a basis of the explanation of other mental phenomena.

I might illustrate this point again by the attention given in the past to the bipartite and the more modern tripartite divisions of mental phenomena. I cannot stop however to enlarge upon this point, for I am here concerned to urge that the moment has arrived when we should lay aside these modes of procedure, and should search for more fundamental characteristics which shall serve to coördinate all the more or less emphatic types of experience; and the firm conviction that I have in the future development of psychology is based upon the fact that a distinct movement in the direction of this higher mode of procedure is evidenced in parts of the work of many of our modern masters.

IV.

Section 8. — In the remainder of this address I wish to present briefly one mode of procedure which seems to me to promise good results in the direction in which true advance is to be made; a mode which I have adopted in my studies, and which I hope some day to present in a more systematic form than I have found possible thus far.

The data which we find ourselves called upon to examine are what we commonly call presentations. These presentations seem on their face to be of very diverse types, some of them being more emphatic and pervasive than others; and as I have already noted we have in the past allowed our attention to be too fully fixed upon the most emphatic form of these types, viz., our sensations.

But these very diverse presentations must display certain characteristics which are common to them all, otherwise we would not thus group them together. It would seem that in the interests of a higher development of psychology we may well look beyond the fact that some presentations are more marked than others, and make it our aim to discover the nature of the

characteristics which always belong in common to all forms of presentations; and then to coördinate these common characteristics, trusting that we may be able to discover fundamental laws which will be found to be exemplified in all of the diverse forms in which presentations are given.

Section 9. — A careful examination of this question in my view must lead us to hold that each presentation in human consciousness must display some measure of intensity, of manifoldness, of stability or realness; must be either pleasant, indifferent, or painful; and must display one of the three time phases, either pastness, or presentness, or futureness.

It is true of course that we do not always note the existence of these qualities in our consideration of presentations, but I think it clear that if we study any specific presentation we will always find in it the characteristics which enable us to say that it is more or less intense; more or less manifold; more or less real; that it is either pleasant, indifferent or painful; and that as a presentation it is one which may be described either as a presentation that is placed in the past, or a presentation that is placed in the future, or as a presentation that is placed in the present.

Intensity, manifoldness, realness, the algedonic quality, and the time quality are thus what I would call the five general qualities of all presentations; and of them I would say a few words.

1. If we agree that what we call vividness is a type of intensity, as I think can easily be shown, it is clear that all presentations display intensity in some measure.

2. It will be generally agreed also that all presentations that are observable in reflection are found upon examination to be more or less complex; *i. e.*, that they display more or less of manifoldness.

3. That psychic stability or realness is a general quality more or less of which must appear in connection with each of our specific presentations is a fact that is not so generally noted.

Each of the presentations which we study in our serious moments of reflection is found to be made up of many minor

presentations, as we may call them, some of which appear as new, and some of which are due to revivals of presentations that are past and gone. In our presentations of reflection, in which we consider the nature of a more or less broken series of what I would speak of as our noetic patterns, certain minor presentations appear in more than one, and some appear in many, of the successive noetic patterns. Each special minor presentation thus displays more or less of stability when it is considered in relation to the successive noetic patterns in which it appears, when these are considered as a group.

It seems to me clear that it is because a presentation displays a marked degree of this noetic stability that we come to describe it as real, and it is for this reason that I have come to speak of this general quality of all presentations as realness.

The recognition of realness as a general quality of presentations is surely in the air. It is implicit in much of Dr. James's work, especially in his studies of belief and what he calls the 'perception of reality'; it is tacitly recognized by Baldwin in distinguishing belief from what he calls 'reality feeling'; and our late President, Miss Calkins, has described it as a distinctive quality of presentations, calling it as she does the 'feeling of realness.' In describing this realness as a *general* quality of all presentations I perhaps take a step further than others have explicitly done.

4. That pain and pleasure are phases of the general quality which I have called the algedonic quality, indifference being a mere transition phase between these two, was my main contention in my *Pain, Pleasure and Æsthetics* published some thirteen years ago; and since its writing I have seen no criticism which has led me to doubt the correctness of this view.

The only formidable opposition to its acceptance is based upon the fact that what we call physical pains are so clearly always painful and always sensational. But, as I have pointed out in the work above referred to there are enormous difficulties connected with the acceptance of the view that pain is itself a sensation, and no difficulty in interpreting the facts discovered in relation to physical pains if we assume that in the cases relied upon to prove the sensational theory we are dealing with special

sensations which are always aroused in painful phase under the conditions which we are able to govern in our experiments.

A theory cannot be held to be satisfactory if it explains merely one set of experiences, but fails altogether to explain others of an equally definite character; and those who hold to the sensational nature of pain can do so only by blinding themselves to the fact that their theory not only fails altogether to take cognizance of a large body of experiences relating to pain and pleasure but actually presents an hypothesis which is incompatible with many of these experiences.[1]

5. That what I call the time quality is a general three-phased quality of all presentations, closely allied in form with the algedonic quality, is a view that I have held for many years, but which I have only lately found myself prepared to state in form worthy of the criticism of my fellow psychologists in my article published in the January issue of *Mind* of 1907; where however a large amount of corroborative evidence has been omitted in consequence of the necessary limits of a Journal article. Even if the hypothesis there presented should prove to be invalid it does not seem to me that we can fail to acknowledge that each presentation in itself displays either pastness, or presentness, or futureness, and that the time quality may therefore be described as a three-phased general quality of all presentations.

Section 10. — It is interesting to note that these general psychic qualities seem to correspond with certain general characteristics which must in some measure appear in connection with each special nervous activity, in the complex system of systems of neural elements which constitute the nervous system of man.

1. Each elementary nervous part must display a greater or less degree of activity, and this when considered in itself constitutes a general characteristic of nervous activity. Now we are agreed that sensational intensity at least changes, broadly speaking, as the degree of special nervous activities changes: and if we extend this observation to cover all other forms of

[1] Confer my *Pain, Pleasure and Æsthetics*, pp. 23 ff. Also article in *Philosophical Review*, Vol. 1, No. 6, entitled 'Pleasure, Pain and Sensation.'

presentation, we are led to see why it is that intensity, as inclusive of vividness, is a general psychic characteristic.

2. When we consider the nature of the nervous system with its highly complex systems of minor systems which are differently integrated as we say, in connection with the great diversities of kind and degree found in the stimuli reaching the system, it appears that no emphasis of activity in any neural element can stand alone, but that it must be related with other emphases of activity of greater or less degree in other elements. Hence we see that each major emphasis of neural activity within the system constituted as it is must display a greater or less complexity of minor emphases of activity, and this when considered in itself constitutes a general characteristic of nervous activity, corresponding altogether with the greater or less manifoldness which is observable in connection with all our presentations.

3. Each special emphasis of neural activity of any importance appears in successive moments, during which the configurations of the complex activities in the nervous system as a whole must alter. It appears therefore that each special emphasis of neural activity must have a greater or less degree of stability in relation to what I have spoken of as successive neururgic patterns if these are considered in relation to one another. And this greater or less stability when considered in itself constitutes a general characteristic of nervous activity. It is with this greater or less of neururgic stability that realness appears to correspond.

That each specific presentation displays more or less of noetic stability when we consider the development of successive noetic patterns seems to me clear: and I think that we are warranted in holding that the experience which leads us to describe presentations as more or less real is determined solely by the stability of specific presentations within successive contexts as these are considered in retrospect.

4. It is impossible to deny that the nature of each elementary neural activity must be differentiated by the relation existing between the stimulus reaching it and its capacity to react to this stimulus; and that in any given moment the neural element must display either hypernormal, or normal, or subnormal efficiency.

That is to say; the energy developed in the reaction must be greater than that given in the stimulus; or else it must be less than that given in the stimulus; or else the stimulus and the reaction must display an equivalence of energy.

It is clear therefore that if we consider this relation in itself we are dealing with a general characteristic of all nervous activity.

That some close relation exists between our pleasures and efficient activities on the one hand, and between our pains and our inefficient activities on the other hand, has been recognized from the earliest times, and was made the basis of theoretical consideration by the early Greek philosophers. I have attempted to show, in the work already referred to, that a satisfactory statement of this relation is possible if we hold on the one hand that the efficiency-inefficiency characteristic is one that applies to neural elements, and that on the other hand, the pleasure-pain quality is one that correspondingly applies to psychic elements.

Differences of neural efficiency must surely involve differentiations in the form of action of neural elements, and if we believe in the validity of the theory of neururgic and noetic correspondences we are surely bound to look for some psychic differentiations corresponding with these differences of neural efficiency. Such we do find in pleasantness and unpleasantness; and those who reject this theory because they are impressed by their physical-pain experiences surely should not rest content until they have shown us some differentiations of consciousness, other than pleasure and pain, which correspond with the differentiations of neural efficiency here considered.

5. It is clear also that each specific emphasis of neural activity, when considered in relation to emphases of like nature in the immediate past, must display either an increasing, or a stationary, or a decreasing, complexity; and when this fact is recognized, and considered in itself, we are evidently dealing with a general characteristic of nervous activity.

In the *Mind* article above referred to I have sketched in outline the basis of my conviction that the diverse temporal phases are closely related with changes in complexity. Whether this hypothesis is valid, or of value, cannot be determined until it

has been subjected to such criticism as I hope it may receive; nor until it is corroborated by indirect evidence such as I find in abundance, and which I hope some day to present for the study of those who think it worth considering at all.

Section 11. — These general qualities of presentations then may be grouped as follows in correspondence with the general characteristics of nervous activity.

General Neururgic Characteristics.	General Qualities of Presentations.
	Group I. Involving the relation of more or less.
Each elementary nervous part must display a greater or less degree of activity.	1. *Intensity.* Each elementary presentation must display more or less of intensity.
When we consider the complex nature of the nervous system we see that each neururgic emphasis must display more or less of complexity.	2. *Manifoldness.* Each presentation as appreciated in reflection must display more or less of manifoldness.
Each specific neururgic emphasis must display more or less of stability in our consideration of successive 'neururgic patterns.'	3. *Realness.* Each specific presentation appears in relation to a context, broader than itself, which is determined by revivals of past presentations; and in relation to this broad context the specific presentation must display more or less of psychic stability or realness.
	Group II. Involving three phases, one of which appears as a transition mode, from which the other two depart in opposite directions.

Each elementary neural activity must display hypernormal, or subnormal, efficiency; or else normal efficiency: this efficiency being determined by the relation of its grade of activity to its capacity for reaction.

Each specific neururgic emphasis, when considered in relation to past emphases of like nature, must display either an increasing complexity, or a stationary complexity, or a decreasing complexity.

4. *The Algedonic Quality.*

Each elementary presentation must display either agreeableness or disagreeableness, or else indifference which is a mode of transition between the other two.

5. *The Time Quality.*

Each specific presentation must display either pastness, or futureness; or else presentness which is a mode of transition between the other two. Each specific presentation appearing as it does in relation to a context, broader than itself, which is determined by revivals of past presentations, must display either an increasing, or a decreasing complexity, or else a stationary complexity.

The hypothesis suggested is that:

The increasing complexity involves futureness.

The stationary complexity involves presentness.

The decreasing complexity involves pastness.

Section 12. — I have spoken somewhat at length of these general qualities of presentations because, if we find ourselves convinced that they exist and are of the nature ascribed to them, we are led to look for certain consequences of no little psychological importance. Of some of these I shall speak briefly in the next division of our subject, but before doing so I shall ask you to consider two examples of the value I find in this mode of approach.

In the first place it may be noted that the conditions of neural activity to which manifoldness, realness and the time quality are supposed to correspond could not appear in an isolated neural element, but only in a complex system of such elements.

On the other hand it appears that if we could isolate a neural element we would find it displaying the condition of greater or less degree of activity to which intensity is supposed to correspond; and also the characteristic relation between degrees of activity and capacity to which the algedonic quality is supposed to correspond.

We are thus led to see that if we could isolate psychic elements, and could observe them in reflection as thus isolated, we would discover in connection with them elemental qualities of the nature of intensity, and of the nature of pain and pleasure, which we may speak of respectively as elemental intensity, and elemental pain and pleasure.

But as consciousness is systemic and not atomic these elemental qualities as appreciated must be transformed; and in the laws governing this transformation much of interest is discovered.

In relation to intensity these laws of transformation furnish a broad explanation of the facts which are related to those grouped together under the formula known as Weber's Law. For it is clear that when we speak of the 'threshold of consciousness' we refer not to a threshold of psychic existence, but to a threshold of awareness, or to use Dr. Stout's phrase a threshold of discernment. And with this fact in mind, it becomes clear that the discernment of any elemental intensity must be dependent upon the relation between its degree and the degree of intensity of the vastly complex systematized mass of psychic elements with which the element whose intensity is examined is correlated and with which it is contrasted.

In relation to the algedonic quality these laws of transformation, as I have attempted to show elsewhere, furnish us with data which serve to explain the indirect and variable relations between pain and organic inefficiency, and between pleasure and organic efficiency respectively; and throw much light upon the nature of our æsthetic experiences.

Section 13. — Turning to my second example, I shall ask

you to consider one implication of the thesis that realness is a general quality more or less of which must attach to all presentations.

Under such a view it would appear that all presentations must have at least some measure of this experienced realness, although this at times may not be appreciated as such: that is to say, they must maintain a momentary stability if they are to appear as presentations at all.

But beyond this; when revived in a later context some presentations will be found to display a greater stability than others, and some so little that they may be described as intrinsically unstable. Or in other words a presentation as such may not maintain this realness — it may almost at once appear to be so lacking in realness that we come to speak of it as unreal, as a 'mere 'appearance'; while on the other hand its realness may be so persistently maintained that we do not hesitate at any time to speak of it as real. And between this minimum of realness which we call unrealness, and this maximum of realness, presentations may display all manner of grades of this psychic stability.

Thus there appear diverse realms of realness, which yield what Dr. James calls diverse 'worlds of reality.' A given presentation may be very unreal in one of the noetic patterns which we experience, while in another it may be very real. For instance the rising and setting of the sun are presentations that are very real from the standpoint of every-day life, but very unreal when one takes the attitude of the astronomer.

If then realness is such a general quality it must attach to concepts, which are a special form of our presentations: and these concepts must appear as more or less real according to the nature of the contexts in which they appear.

But what we speak of as reality when we are concerned with metaphysical considerations is a concept; and it therefore follows that special forms of the reality concept must have more or less of realness, more for you perhaps than for me. Bradley's absolute for instance is a concept which is practically of the same nature for all who study it carefully. We are bound to assume that it is very real for him; but it is surely less real for Professor Royce, and thoroughly unreal for Dr. James and Dr. Schiller.

This leads us to see that it is necessary to draw a sharp line of distinction between the objective concept reality, and realness which is a subjective characteristic; a distinction which is often overlooked by psychologists who not infrequently use the phrase 'perception of reality' when they refer to what may more properly be described as 'the appreciation of realness.'

A study of this point also brings out clearly the fact that what we call belief is a subjective state which is determined not by the nature of any conceptual reality, but by our reaction upon it in giving this concept an established realness. It thus appears that we should also make a sharp distinction between reality and the belief that relates to this reality; and in my view a careful consideration of this distinction serves to throw much light upon the troublesome problems related to belief.

But these distinctions are not commonly maintained either in thought or language; and I am inclined to think that the current somewhat acrimonious debate between the absolutist and the pragmatist is largely due to the fact that the two parties to the controversy too often deal with altogether different problems; the contestants being led astray by the very common everyday ambiguous use of the terms truth and true, reality and real.

We commonly and carelessly speak of that as a truth which we appreciate as having realness for us, and which we are wont to speak of as true. But we are here dealing with the record of a concrete case of our appreciation of realness, and not with the nature and meaning of the metaphysical concept which we designate the truth.

So again commonly and carelessly we speak of that as a reality which we appreciate as having realness for us, and which we are wont to describe as real. But here again we are dealing with a concrete case of our appreciation of realness, and not with the nature and meaning of the metaphysical concept which we also designate by the word reality where we do not call it the real.

The ontologist is concerned to examine the nature and meaning of the concepts the true, or truth; the real or reality; part of the connotation of which is that they remain unaltered whatever be the vicissitudes of human experience. Any one of

which concepts, be it noted, may display more or less of realness, and may be more or less acceptable as stable, thus in greater or less degree determining belief. And as such it may be spoken of according to current usage as real or true, these words being employed to designate our experience of noetic stability.

But it is not clear that the pragmatist is properly concerned to examine the nature and meaning of the concepts the true, or truth; the real or reality. He is concerned rather with a problem which the ontologist may choose to ignore; viz., with the consideration of the process by which the realness of any presentation whatever becomes established, and with the possibility of the restatement of this process in terms of workableness for human purposes, and of consequent values for men.

VI.

Section 14. — We may now turn in closing to a brief consideration of some of the consequences which follow from the mode of study I am here advocating.

It will be clear upon consideration, as I have already noted, that while some phase of each of the general qualities above considered must attach to all of our presentations, it is not at all necessary that their existence should always be appreciated, for they may not be at all emphasized: and it is apparent when we turn to introspection that such is the case.

And this leads us to note that the appreciation of the existence of each of these general qualities is determined by the appearance in consciousness of a special form of presentation, each of which is *sui generis*, and is one of those 'senses of relation' which Dr. James has taught us are so innumerable.

Having gone thus far we are led to note that if some phase of each of these general qualities is given in connection with each presentation, then all of them are in some measure given together in connection with each presentation, although not all are likely to be equally prominent.

This leads us to see that where certain of the phases of these general qualities are coincidently emphatic we should expect to observe the appearance of new and distinctive *combinational* 'senses of relation,' as we may call them, which might well appear to be important.

And if we enter into an investigation suggested by this thought we are led to results of great general interest.

If for instance we imagine a case in which there is an appreciation of a marked intensity of a partial presentation within a whole presentational complex, and at the same time an appreciation of the whole complex itself as manifold; then we might expect to note the appearance of a new combinational 'sense of relation' determined by the relation of the two phases of the two general qualities intensity and manifoldness as thus appreciated.

And when we ask ourselves whether such a combinational sense of relation is ever observed we note that the general neururgic conditions determining its appearance would be very similar to those constantly observed in one special limited part of the nervous system, *i. e.*, to the retinal conditions where the eye is powerfully stimulated, for there we have an activity of high degree in a limited part in relation with a broad but less active retinal field.

We see thus that we would be likely to describe the broader conscious experience involving the recognition of the relation of intensity to manifoldness in terms of the narrower but more vivid and usual ocular presentation. When therefore we note that we commonly describe the experience of attention in ocular terms as displaying a focus within a broader field we are at once led to see that when we appreciate the existence of attention we do so because we experience a presentation of a special form — a combinational sense of relation — in which we grasp the relation existing between a marked intensity within a given presentational complex, and the manifold nature of the presentational complex apart from the intense element.

In a similar way, if we imagine a case in which there is an appreciation of a marked realness of a partial presentation within a whole presentational complex, and at the same time an appreciation of the whole complex itself as manifold, then again we might expect to note the appearance of a new combinational 'sense of relation' determined by the relation of the two phases of the two general qualities realness and manifoldness as thus appreciated. And when we look for such a new

combinational sense of relation we find it in my view in the object-subject relation.

In looking for similar 'senses of relation' due to the coincident emphasis of realness and the time phases we find them: in relation to pastness in familiarity, and its development in memory; in relation to futureness in anticipation, and its development in expectation.

Section 15. — Turning again to the development of the method with which we are here concerned we may note that after we have considered in detail the general qualities of all presentations in all their bearings; and after we have studied those resultant combinational 'senses of relation' due to the coincident emphasis of two or more phases of these general qualities in connection with a given presentation; then we may properly consider the nature of, and the conditions of appearance of certain qualities which are not general qualities in the sense that they are appreciable in connection with all presentations, but which nevertheless are of such general occurrence that they may well be mistaken for such general qualities.

It is to be noted that the existence of each of these special qualities will be due to the appearance of a special 'sense of relation' presentation.

The most important of these frequently occurring special qualities is that which I would call the spatial quality.

The spatial quality cannot be called a general quality of all presentations; for it cannot be shown that all presentations are spatially qualified, as the philosopher and the common man implicitly agree when they describe the mind as non-extended and immaterial. Such presentations for instance as 'theory of consciousness,' 'virtue,' 'algebraic functions,' taken in themselves as presentations, do not appear to display any spatial qualifications whatever; they cannot be said to be here or there in space.

But on the other hand as it is clear that a very large proportion of our experiences are spatially qualified, although we should not treat of the spatial quality as of primary importance, we nevertheless should give special attention to the nature of the situations which induce the appearance of this special spatial quality which Professor Judd will agree with me in describing

as a quality of relation, and which can only be appreciated because of the appearance of a special 'sense of relation' presentation.

Section 16. — Finally when we have studied thus the nature of the general, and of the broadly occurring special, qualities of presentations we are in position to consider in detail the nature of specific presentations which seem to be clearly differentiated from one another — our sensations, our percepts, our concepts, our instinct experiences and emotions, our acts of will; which appear from such a point of view as special psychic emphases which are differentiated because of their divergent psychic *loci*, if we may so speak; just as the special nervous activities with which they correspond may be described as special neururgic emphases within certain limited parts of the nervous system all parts of which are in some measure active at all times.

Section 17. — Through the whole course of such a study we are compelled to take cognizance of the fact that the presentations given in reflection are only part of the whole of the state of consciousness considered, and that in any given instant the part of consciousness which we call the Self is existent although it is not presented and in fact is non-presentable.

Considering then that, if consciousness is a system, all parts of it must be fundamentally of the same nature, and all parts reciprocally efficient, it appears that the non-presentable Self, and the presentations to this Self, must always affect each other; and the appreciation of this fact in connection with the mode of approach suggested serves to throw much light upon many questions of current interest. It leads us to see for instance that no valid distinction can be made between voluntary and involuntary attention, for the action of the Self must be involved in every act of attention although at times this action may be obscured and overlooked. It shows us that belief under such a view appears as the establishment of realness by that simulacrum of the Self which we call the empirical ego; each act of belief being seen to involve a voluntary resolution of the deadlock of doubt; and this leads us to see that whenever we experience an act of belief we actually must experience an act of will, or in other words must necessarily 'will to believe'; a fact that

clears up much of the difficulty encountered in the discussions of the morality of believing as we desire to believe, in cases where the evidence on the side to which our desire presses us is not convincing; for it takes this question out of the realm of psychology and shows us that the same canons of ethics are applicable to this willing 'to believe at one's own risk' that are applicable to all our voluntary acts.

Section 18. — With this general outline of the method suggested I must content myself here. I myself am inclined to think that it is likely to prove to be a useful method; but even if when put to the test it be discovered to be lacking in value, this fact will not force me to abandon the conviction that the time is ripe for the adoption in psychology of a new method which shall look beneath the superficial, in search for the more fundamental, aspects of our conscious experience.

STUDIES FROM THE BRYN MAWR COLLEGE LABORATORY.

THE EFFECT OF THE BRIGHTNESS OF BACKGROUND ON THE APPEARANCE OF COLOR STIMULI IN PERIPHERAL VISION.

BY GRACE MAXWELL FERNALD.

Introductory Statement.

The present investigation is a direct continuation of one carried out in 1903–4 in the Mt. Holyoke laboratory.[1] The results of this earlier paper were based on observations of the appearance of the colors at the red-yellow end of the spectrum when seen in peripheral vision, and were in brief as follows:

I. The brightness of a colorless background has a decided effect: (1) On the limits for yellow and orange, the limits for the former color being much wider with the darker grounds, for the latter color wider with the lighter grounds. (2) On *the tone* of red, orange and yellow, the component of the color least like the background in brightness being emphasized in every case — namely, the red with the light background, and the yellow with the dark background. Orange, which showed a greater variation than any other color, appeared as red with the light backgrounds at the same degree of eccentricity at which it appeared yellow with the dark backgrounds. The brightness of the background seems to have no effect on blue.

II. After-images are often experienced at the periphery even when the tone of the stimulus color is not seen.

A monograph by Dr. Baird,[2] which appeared after our paper had gone to the printer, gives the results of an investigation of peripheral vision under conditions of dark adaptation. His

[1] Psychol. Rev., Vol. XII., 1905, pp. 386–425: 'The Effect of the Brightness of a Colorless Background on the Extent of the Color Fields and on Color Tone in Peripheral Vision.'

[2] J. W. Baird, 'The Color Sensitivity of the Peripheral Retina,' Carnegie Monograph, May, 1905.

conclusions, based on results obtained under invariable conditions of background and adaptation, have a bearing on our problem, since they represent the extreme case of dark adaptation and of brightness, contrast between stimulus and background. They are in brief as follows:[1]

(1) "With a slight luminosity of stimulus, all colors appear colorless at the periphery of the retina." (2) "When they are brought in far enough to appear colored, those of the red end of the spectrum first appear yellowish or yellow, while those of the blue end first appear bluish or blue. . . ." (3) After-images, 'in the ordinary sense of the term,' were reported in but few cases, and then only when the paracentral regions of the retina were stimulated. Latent after-effects, however, seemed to persist after the stimulation, and to be influential in determining the color-effect of succeeding stimuli, when too short an interval was allowed between tests.

In December, 1905,[2] an investigation reported by Miss Gordon and Miss Thompson at the Harvard meeting of the American Psychological Association, gives detailed results, showing the effect of a colorless background on the color tone and on the frequency of occurrence of the after-image. The results, as summarized in the PSYCHOLOGICAL BULLETIN, are as follows:[3]

"Finer discriminations are made in the red-yellow end of the spectrum than in the blue-green end, both in stimulus and after-image, for (1) on the part of the retina where the stimuli red, orange and yellow were distinguished from one another, their after-images were not differentiated, *i. e.*, each of these three colors produced pure blue after-images, and (2) on a part of the retina where the stimuli green, blue and violet were not distinguished from one another, but all appeared blue, the after-images to these colors were differentiated, being respectively orange-red, orange, and greenish yellow."

[1] The results with reference to the 'stable colors' or 'Urfarbe,' as well as other observations which do not bear on our problem are omitted here. For a full summary of results, see Carnegie Monograph, May, 1905, p. 72.

[2] This paper was published in full in the PSYCHOLOGICAL REVIEW, Vol. 2, March, 1907, pp. 122–167.

[3] Summary statement, PSYCHOL. BUL., Vol. III., 1906, p. 66

Experimental.

The purpose of the present investigation was to determine the effect of the brightness of a colorless background on the carmine, violet, green-blue, and green, of the Hering series.

Observers.

Miss Edith Claggett and Miss Lida Popejoy, graduate students at Bryn Mawr College, Miss Blanche Hecht, a junior, and the writer, served as observers in the present investigation. Miss Adelaide Case, a sophomore, conducted the experiment, while the writer served as observer.

Apparatus.

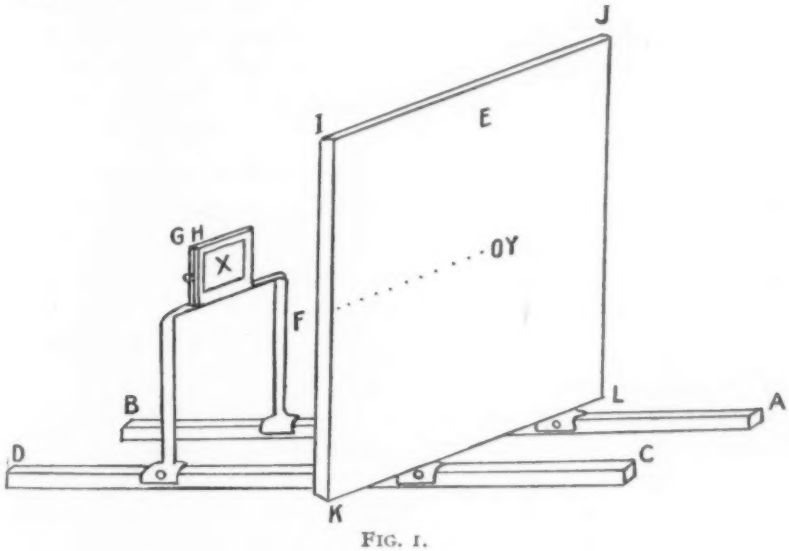

Fig. 1.

The apparatus employed in our earlier work [1] has been modified in several respects. In order to make possible a more comfortable position on the part of the observer and a more steady head fixation, a vertical campimeter was adopted in place of the horizontal. The campimeter frame *IJKL* (see Fig. 1) was fastened to heavy iron bars *AB* and *CD*, which were placed, parallel to each other, on a long table. Behind the frame *IJKL* was an iron support *F*, which was also secured to the iron bars *AB* and *CD*. This support carried a frame,

[1] Psychol. Rev., Vol. XII., 1905, pp. 393–394.

furnished with two grooves, *G* and *H*, into which small frames could be slid. A gray slide (*x* in the diagram), like the background in brightness, was fitted into the first of the two frames, *i. e.*, the one toward the campimeter, and the stimulus color into the second.

The backgrounds consisted of Hering gray paper, numbers 1, 3 and 34, and when in use, were fastened to the frame *IJKL* (see *E* in the diagram). A circular opening *Y*, 1.2 cm. in diameter, was made in the center of each background. Fixation points measuring degrees, calculated on a basis of an arc of 25 cm. radius, were marked out on the background, starting with the center of the opening *Y* as zero. As the limits for the nasal meridian could not be obtained on the flat surface of the campimeter, a second frame was attached to the main campimeter frame, perpendicular to the surface of the campimeter along the edge *IK*.[1]

The stimuli consisted of Hering colored papers and various shades of Hering gray. Blue, violet, carmine, green-blue and green, gray No. 34 and gray No. 3 were most frequently given as stimuli, though the other colors and the other shades of gray were frequently interposed in the series.

The work was all done in a room, whose walls and woodwork were of white or gray. The illumination came from a skylight which occupied practically the entire ceiling of the room. Gray and white curtains were so arranged that the illumination could be controlled at will.

A circle was so drawn on the gray slide that its center was in the line perpendicular to the surface of the campimeter at the center of the opening.[2] This circle was just large enough so that, when the eye of the observer was 25 cm. from the campimeter and the visual axis was perpendicular to the center of the circle, the circle on the screen would appear to just fit inside the circular campimeter opening. It will be seen that the eye position just described is the only one in which the two circles will appear concentric.

The head was held in position during stimulation by means

[1] For diagrams see PSYCHOL. REV., Vol. XII., 1906, p. 394.

[2] A cathetometer was used to determine the center of the circle.

of a vulcanized rubber mouthpiece in which a deep indentation of the observer's teeth had been made. It is evident that when the apparatus had once been adjusted, the head position was absolutely determined, provided the mouthpiece was secure. To insure the stability of the mouthpiece, it was fastened to a triangular support which was screwed to the table.

Method of Experimentation.

The observer was seated in front of the campimeter and the mouthpiece was so adjusted that the right eye was in a correct position with reference to the campimeter opening. The observer then moved the eye from the center of the circle to a given fixation point. This fixation point was held while the experimenter after an exchange of signals gave the stimulus by pulling out the gray screen which covered the color. After a given length of stimulation, the screen was pushed back, and the observer held the fixation until every trace of after-image had disappeared. After a two minute interval, the proceeding was repeated with the same or another stimulus. The stimuli were given in irregular order, the black, white, and gray being frequently interposed between the color stimuli. The observer was kept in complete ignorance throughout concerning the nature of the stimulus.

Results.

I. *Limits of the Color Fields.* — Carmine is the only color whose limits seem to be affected to any extent by change in the brightness of the background. Its limits, like those of yellow, are decidedly wider with the dark background than with the light background. The field for violet is if anything wider with the light background. The actual limits as indicated in Tables I., II. and III. are as follows:

LIMITS FOR CARMINE.

Observer F.	*Observer H.*
Background No. 1 — 60° (?)[1]	Background No. 1 — 70°
" No. 3 — 65°	" No. 3 — 70°–75°
" No. 34 — 80°	" No. 34 — 75°–80°

Observer P.

Background No. 1 — 75°
" No. 3 — 75°
" No. 34 — 80°–85°

LIMITS FOR VIOLET.

Observer F.	*Observer H.*
Background No. 1 — 60 (?)	Background No. 1 — 40° + (?)
" No. 3 — 45°–50°	" No. 3 — 40°
" No. 34 — 40°	" No. 34 — 30°–40°

Observer P.

Background No. 1 — (?)
" No. 3 — 45°
" No. 34 — 30°–40°

Unfortunately the results for green-blue and for green are not sufficiently well marked or complete to justify any conclusions with reference to their color limits. The observers were especially troubled by the decidedly unsaturated green of the Hering series. The judgments concerning it were uncertain almost to the center of vision. Thus while practically as many results were obtained with green as with the other colors, the results are purely negative. If time had permitted the experiment would have been continued by work with green in the more central regions.

II. *Effect of the Brightness of the Background on Color Tone.* — It was shown in our previous work that red, orange, and yellow are seen as yellow much more often with the dark than with the light backgrounds. For example, with the light background (*i. e.*, Hering gray No. 3) orange was seen as yellow only three times out of 156 tests,[1] as yellow-orange 11 times, as orange 24 times, and as red 102 times. The same orange, with the dark background, was seen as yellow 31 times, as yellow-orange 23 times, as orange 35 times, when the total number of tests was only 92.[2]

The background seems to have no effect on blue, violet, and carmine, analogous to that just described. The main effect of the background on the tone of these three colors, as indicated by our results, is a tendency on their part to appear blue with the dark backgrounds, at the same points at which they appear colorless with the light background. A possible excep-

[1] The interrogation mark means that the results were not sufficiently complete to justify a more positive statement.

[2] These totals include cases in which no color was seen. See PSYCHOL. REV., Vol. XII., 1905, p. 398.

tion to the above statement occurs in the case of carmine, which is frequently described as more reddish with the light than with the dark background.

The following tables give the percentage of cases in which the colors in question were seen as blue. The percentage is based on a total made up of the results of all observers. Tables I., II. and III. must be consulted for the distribution of the stimuli.

Carmine	seen	as	blue	with	background	No. 34, 13 %	of	total number of tests.
"	"	"	"	"		No. 3, 9 %	"	" "
Violet	"	"	"	"		No. 34, 88 %	"	" "
"	"	"	"	"		No. 3, 67 %	"	" "
Green-blue	seen	as	blue	with	background	No. 34, 54 %	"	" "
"	"	"	"	"		No. 3, 49 %	"	" "

III. *Effect of the Brightness of the Background on the After-Image.* — Our results with reference to the after-image, are confirmatory of those obtained by Miss Thompson and Miss Gordon[1] (see introductory statement, p. 26). The following tables give the percentage of cases in which no after-image was seen, as well as the percentage of cases in which an after-image of a given color tone was seen. These percentages are based on totals which include the results of all observers. A study of the individual results as given in Tables IV. to X. shows the same general tendency in the results of each observer as that represented in the totals here given.[2]

CARMINE.

	Background No. 3.	*Background No. 34.*
	Total number of tests, 139.	Total number of tests, 83.
No after-image,	50 per cent.	77 per cent.
Yellow after-image,	22 per cent.	4 per cent.
Green after-image,	28 per cent.	19 per cent.

VIOLET.

	Background No. 3.	*Background No. 34.*
	Total number of tests, 114.	Total number of tests, 79.
No after-image,	17.5 per cent.	25 per cent.
Yellow after-image,	58 per cent.	33 per cent.
Green after-image,	24.5 per cent.	35 per cent.
Reddish after-image,		7 per cent.

[1] PSYCHOL. REV., Vol. XIV., 1907, pp. 127-134. Our experimental work was all completed before the publication of Miss Thompson's and Miss Gordon's paper. Consequently our results were obtained entirely independently of theirs.

[2] Tables I. to III. must be consulted for the distribution of the stimuli.

GREEN-BLUE.

	Background No. 3.	*Background No. 34.*
	Total number of tests, 81.	Total number of tests, 55.
No after-image,	16 per cent.	33 per cent.
Yellow after-image,	67 per cent.	11 per cent.
Orange after-image,	17 per cent.	36 per cent.
Red after-image,		20 per cent.

Relative Frequency of After-Images with the Light and Dark Backgrounds. — The tables show that, in the case of all three colors, after-images are observed less frequently with the dark than with the light background, the total percentage of cases in which no after-image was experienced being 47 with the dark background and 28 with the light background. As the results upon which these percentages are based include cases in which the stimulus color was not perceived, it is interesting to note that the statement just made holds in spite of the fact that the percentage of cases in which the stimulus color was not observed was over twice as large with the light background as with the dark background.

Effect of the Background on the Color Tone of the After-Image.

After-Image of Green-Blue. — The most striking effect of the background on the color tone of the after-image is seen in the case of green-blue, namely, in the only case in which the after-image in central vision is orange or reddish. With the dark background, the reddish component of the after-image is emphasized, while, as shown by our previous work, the reddish component of the stimulus color is emphasized with the light background. With the light background, the after-image for green-blue tends to be yellow; with the dark background, orange or red. The tables show that yellow after-images were seen in 67 per cent. of the total number of tests with the light background, and in only 11 per cent. with the dark background. Moreover, with the dark background, the after-image was orange in 36 per cent. of the total number of tests, and red in 20 per cent., while it was orange in only 17 per cent. of the total number of tests with the light background, and never red.

After-Image of Violet. — With the dark background the after-image for violet tends to appear green, while with the light background it more often appears yellow.

After-Image of Carmine. — Although after-images, especially with the dark background, followed carmine in so few cases, the after-image, when seen, was almost invariably green with the dark background, and was frequently yellow with the light background.

The following percentages, based only on cases in which after-images were seen, show more clearly than the tables in the preceding section, the proportion of after-images of a given color observed with each of the backgrounds.

CARMINE.

Background No. 3.	*Background No. 34.*
Total number of after-images = 69	Total number of after-images = 19
After-image = green 58 per cent.	After-image = green 84 per cent.
" = yellow 42 per cent.	" = yellow 16 per cent.

VIOLET.

Background No. 3.	*Background No. 34.*
Total number of after-images = 95	Total number of after-images = 58
After-image = green 30 per cent.	After-image = green 48 per cent.
" = yellow 70 per cent.	" = yellow 51 per cent.

GREEN-BLUE.

Background No. 3.	*Background No. 34.*
Total number of after-images = 68	Total number of after-images = 37
After-image = orange 21 per cent.	After-image = orange 54 per cent.
" = yellow 79 per cent.	" = yellow 16 per cent.
	" = red 30 per cent.

Colored After-Images of Unperceived Color Stimuli.

In agreement with the observations already made in our first paper, and later in the work of Miss Thompson and Miss Gordon, our results show, that in many cases a characteristic colored after-image follows an unperceived color stimulus. In general this after-image is perfectly clear and distinct. Such after-images are perceived most frequently either just inside or just beyond the regular limits for the color, and are more often observed with a light than with a dark background. With the light background, out of 85 cases in which the stimuli, violet, carmine and green-blue were not perceived, a colored after-image was seen 26 times, or in 31 per cent. of the total number of cases. With the dark background, out of a total of 24 cases, in which the stimulus was not perceived, the after-image was

seen only twice. The following table gives results based on Tables IV. to XII.

BACKGROUND No. 3.

Color.	No. of Times not Seen.	After-Image Seen.
Violet	13	1 green 2 yellow
Carmine	57	2 " 14 "
Green-blue	15	7 "
Total	85	Total after-images seen = 26.

The following table is based on results obtained with observer H. on the temporal meridian. (Background No. 3.) (For complete results see Table XIII.) After-images were seen in 10 out of 34 tests in which the stimulus color was not seen or in 29 per cent. of the total number.

Color.	No. of Times not Seen.	AfterImage Seen.
Yellow	5	
Carmine	10	3 Green
Violet	9	4 Yellow
Blue	10	3 Yellow
Total	34	After-images seen = 10.

The following results were obtained with observer C. on the older form (*i. e.*, horizontal) campimeter. (For complete results see Table XIV.) Out of 56 tests, with both backgrounds, in which the stimulus color was not seen, after-images were seen 16 times or in 29 per cent. of the total number.

Background.	Color.	Stimulus Color not Seen.	After-Image Seen.
No. 3	Yellow	9	4 Blue
No. 3	Blue	16	7 Yellow
No. 34	Yellow	13	2 Blue
No. 34	Blue	18	3 Yellow

Total number of tests in which stimulus was not seen with Background No. 3 = 25.

Total number of after-images = 11.

Total number of tests in which stimulus was not seen with Background No. 34 = 31.

Total number of after-images = 5.

That the phenomena here described are genuine after-images is shown by the fact that the color is in every case the color complementary to the stimulus as perceived either in central or in peripheral vision, although the observer was kept in complete gnorance concerning the nature of the stimuli employed, and so had no clew as to what after-image was to be expected in

cases in which the stimulus was not seen. Moreover gray and white, though frequently used as stimuli, were never followed by colored after-images.

Effect of the Duration of the Stimulus on the Appearance of the After-Image.

It has been suggested that one reason why peripheral after-images were not perceived in Dr. Baird's work, and were of frequent occurrence in ours, is that his time of stimulation was three seconds throughout, while in our experiments the color was exposed until it had completely disappeared. Our time records show that, almost without exception, at the outer peripheral regions at which the color was perceived, the time of stimulation was less than two seconds. Consequently it seems safe to assume that the length of the stimulation cannot be responsible for the difference in the two sets of results.

It might be stated here that results obtained when the time of stimulation was arbitrarily shortened to one second, showed no decrease in the percentage of after-images perceived.

Conclusions.[1]

I. The brightness of an achromatic background has a decided effect on the degree of eccentricity at which orange, yellow and carmine can be perceived, but seems not to have a similar effect on blue, green-blue and violet. Yellow and carmine are seen as yellow and carmine respectively at a greater degree of eccentricity with the dark than with the light backgrounds, while with orange and perhaps with red and violet the effect is reversed.

II. Red, orange and yellow tend to appear red or orange with the light background at the same fixation points at which they appear as yellow with the dark backgrounds. The only similar effect observed in the case of blue, green-blue, violet and carmine, is a tendency on the part of all these colors to appear bluish with the dark background at the same points at which they appear as colorless with the light background. A possible exception to the above statement occurs in the case of carmine,

[1] These conclusions are based on the results of papers I. and II. and inclued those obtained by Miss Gordon and Miss Thompson.

which was often described as slightly more reddish than the stimulus, when observed on the light background.

III. The brightness of an achromatic background has a decided effect (1) on the frequency with which a stimulus color is followed by an after-image (in peripheral vision); the tendency of the lighter background being to emphasize the after-image and of the dark ground to obliterate it; and (2) on the tone of the after-image perceived; the after-images with the light background tending to appear as blue or yellow and with dark background as reddish or greenish. The dark background has a greater effect on the red than on the green component of the after-image.

IV. The duration of the stimulus color, within limits of from one to three seconds, seems to have little effect on the appearance or frequency of the after-image.

Theoretical. — As suggested by Miss Gordon and Miss Thompson, two factors in addition to the tone of the color stimulus and its retinal location, seem influential in determining the tone of the color perceived in peripheral vision, namely (1) the brightness of the background, and (2) the brightness of the color itself. The brightness of the color is necessarily affected by contrast with the brightness of the background, and, in the case of the after-image, by the brightness of the stimulus and by the brightness of the screen upon which the after-image is projected. As it seems impossible at present to determine which of these two factors, namely (1) brightness of the color and (2) brightness of background, is more effective in producing the results described in this paper, and as we are at present at work on the problem, we shall postpone any theoretical discussion until a later paper. It seems probable, however, that the results may be, to some extent, at least, related to the Purkinje phenomenon observed in central vision.

In concluding I wish to express my indebtedness to Professor James H. Leuba, of Bryn Mawr College, for suggestions and criticism throughout the investigation and to Dr. Helen Thompson Woolley for suggestions with reference to the general problem.

TABLE I.[1]

OBSERVER F. NASAL MERIDIAN.

Background.	Stimulus.	Color Seen.	40°.	45°.	50°.	55°.	60°.	65°.	70°.	75°.	80°.	85°.	90°.	95°.	100°.
No. 1	Violet	Violet				1*y*	1*y* 1								
No. 1	"	Blue					2*y*	3*y* (1)	4*y*						
No. 3	"	Violet	1*g*	5*g*	2*g*					1*g*		I			
No. 3	"	Blue	1*g*		1*g*	1*g* 2*y*	3*v*	1*y*	1*g* 1*y*	1*y* 1 (1)	1*g* 2*y*	1*y*	1*y*(1*y*)		
No. 34	"	Violet	4*g*												
No. 34	"	Blue	1*g*	3*g*	1*g*	1*g*	2*g*	2*g* 1(*g*)	2*o*	2*o* 3*g*	1*o* 1 (1?)	1(1)		1	
No. 1	Carmine	Carmine				1	2 (1) II	II (I)	III (I)						
No. 1	"	Blue					1	(2) (1*g*)	1						
No. 3	"	Carmine	1*g*	2*g*	1*g*	4*g*	2*g*(1*g*)1	4 II*y*	III I*y* I*g*	II II*y* (I*g*)	II (1) I*y* I*o*	I*y* I	II	I I*y*	
No. 3	"	Blue					1	1*g*			(1*g*)1	2		1*y*	
No. 34	"	Carmine	1*g*	1*g*	1*g*	1*g*(1?)	1? 1*g*	1*g* 2 (1)	2	2 (2)	4		I	I	
No. 34	"	Blue									1	2(1)	1(1)		
No. 1	Green Blue	Green Blue													
No. 1	"	Blue					1*y*	3*y*							
No. 3	"	Green Blue	1*o*	1*o*	1*o*	2*o*	1*y*				1*y*	I	I*y*	I	
No. 3	"	Blue				1*o* 1*y*	1*y* 1*o*		1*o*	2*y*	2*y* 1	1*y* 1		1	
No. 34	"	Green Blue	1*o*	2*o*	1*o*		4*o*	1				1	I		
No. 34	"	Blue						3*o* 1*y*	2*r*	4	1	I			
No. 1	Black	"					I	I	I						
No. 3	"	"			I	III	IV	I	II	II	V(I?)	II	IV II*y*		
No. 34	"	"	I	I	I	I	I	III	II	III	II	II	I	I	

[1] For explanation of the tables, see p. 43.

Table II.

Observer H. Nasal Meridian.

Back-ground.	Color.	Color Seen.	25°.	30°.	35°.	40°.	45°.	50°.	55°.	60°.	65°.	70°.	75°.	80°.	85°.	90°.	95°.	100°.
No. 1	Violet	Violet				3*g*	1*g*	(1*y*)1*g*	2*g*	I I*y*			I	I (*g*) I				
No. 1	"	Blue				1*y*	1*g* 2*y*			1*y*	1(*y*)	1*y*	2*y* (1*y*)					
No. 3	"	Violet	1	1*y* 1*g*	1*g*(1*y*)(1*g*)	2*y*				I*y*					I	II	III	
No. 3	"	Blue				2*y*	3*y*	3*y*	1*y* 1?	5*y*	1 1*y*	4*y*	3*y*	6*y* 1	1*y* 2	1*y* 1		
No. 34	"	Violet		1*g*	1*g*	2*g*(1*y*)		(1*g*)								II	I	I
No. 34	"	Blue	1*g*	3*g* 1*y*			3*y* 1*g*		1*y* 1			(1) 1*r*	1*g* 1	1	1*y* 1			
No. 1	Carmine	Carmine				1*g*			1		2 1(*g*) 1*g*	3 1*g* II	IV (1)	II				
No. 1	"	Blue																
No. 3	"	Carmine						1*g*	3*g*	2*g* 2(1)	3*g* (1) I	4 III(2)	3 III(1)	IV 1(4)	VI	II	I	
No. 3	"	Blue																
No. 34	"	Carmine				1*g*	2*g*	1	1	1*g*	1	2	5 I (1)	3 III	III	I		I
No. 34	"	Blue																
No. 1	Grn. Blue	Grn. Blue				1*y*		1*y*	1*o*		1*y*	(1*y*) 1*y*		I (*y*)				
No. 1	"	Blue											1					
No. 3	"	Grn. Blue				2*y*	1*o*	2*y*	4*y*	3*y* I*y*	2*y*	I*y*			II	II	I	
No. 3	"	Blue							1*y*	3*y*	2*y*	3*y*	3*y*	2*y* (1*y*)	1*y* 2			
No. 34	"	Grn. Blue			1*y*	1*o*	2*o*	1*o*		1*o*		1*r*	1*o*	I				I
No. 34	"	Blue							2*o*				1*o* 1*y*(1)	1	1	1*y*		

TABLE III.

OBSERVER P. NASAL MERIDIAN.

Back-ground.	Stimulus.	Color Seen.	20°.	25°.	30°.	35°.	40°.	45°.	50°.	55°.	60°.	65°.	70°.	75°.	80°.	85°.	90°.	95°.	100°.
No. 1	Violet	Violet							1*y* I					II*y*					
No. 1	"	Blue								2*g* 1*y*	I	2*y*	1*y*						
No. 3	"	Violet					2*g*	2*g*	1*g*	1*y*	1*g*							II	I*y* I
No. 3	"	Blue							2*y*	1*y* 1*g*	2*g*	1*y*	2*y*	4*y*	3*y*	3*y*			
No. 34	"	Violet	(1*y*)																I
No. 34	"	Blue[1]	1*y*	2*y*		2*y*	1*y*				1*y*	1*y*	1*y* I	1*y*	1*y*	1*y*	3*y*	2 2*y*	I
No. 1	Carmine	Carmine							1*g*		1*g*		1*y* 1*r*	2*y* I	III				
No. 1	"	Blue																	
No. 3	"	Carmine			2*g*	3*g*			1*g*	2*g*	3*g*	2*g*	1*g* 1*y* I*y*	1*g* 3*r* I	III II*y* 1*y*	II*y* I	I	III	I
No. 3	"	Violet					1*g*				(1*g*)	1*y*	3*y*	2*y*	1*y*				
No. 34	"	Blue														1*y*	1*y*		
No. 34	"	Carmine									1*g*	1*g*	2*g*	2*g* I	3 I*y*	I 1*y* I*y*	I I	I	I
No. 34	"	Violet														I		I	
No. 34	"	Blue															3	3	I
No. 3	Black[2]	"			I	I					I	I	II I*b*	III I*b*	V	III Or *b*	I		
No. 34	"	"													I	I	I	II	II

[1] In five cases the after-images designated were brownish and unsaturated.

[2] This black was ordinary black pasteboard and showed a slight tendency to appear reddish. The after-images were very faint and indistinct.

TABLE IV.

OBSERVER P.

Violet.	Background No. 1.				Background No. 3.				Background No. 34.			
Color.		A.-I. Green.	A.-I. Yellow.	No A.-I.		A.-I. Green.	A.-I. Yellow.	No A.-I.		A.-I. Green.	A.-I. Yellow.	No A.-I.
Seen as Violet.	1		1		7	6	1		(1)		1	
" " Blue.	7	2	4	1	19	3	16		21		17	4
Not Seen.	3		2	1	4		1	3	1			1
	Total No. Tests = 11.				Total No. Tests = 30.				Total No. Tests = 23.			
	After-image Green = 2.				After-image Green = 9.				After-image Green = 0.			
	" " Yellow = 7.				" " Yellow = 18.				" " Yellow = 18.			
	No After-image = 2.				No After-image = 3.				No After-image = 5.			

TABLE V.

OBSERVER H.

Violet.	Background No. 1.				Background No. 3.				Background No. 34.			
Color.		A.-I. Green.	A.-I. Yellow.	No A.-I.		A.-I. Green.	A.-I. Yellow.	No A.-I.		A.-I. Green.	A.-I. Yellow.	No A.-I.
Seen as Violet.	7(1)	7	1		6(2)	3	4	1	4(2)	5	1	
" " Blue.	9(1)	1	(1) 7 1?		36		30	5 1?	17(1)	6	6(1?)	4(1)
Not Seen.	5	1?	1	3	7		1	6	4			4
	Total No. Tests = 23.				Total No. Tests = 51.				Total No. Tests = 28.			
	After-image Green = 8.				After-image Green = 3.				After-image Green = 11.			
	" " Yellow = 10.				" " Yellow = 35.				" " Yellow = 7. (1 reddish)			
	No A.-I. or A.-I. doubtful = 5.				No After-image = 13.				No After-image = 9.			

TABLE VI.

OBSERVER F.

Violet.	Background No. 1.				Background No. 3.				Background No. 34.			
Color.		A.-I. Green.	A.-I. Yellow	No A.-I.		A.-I. Green.	A.-I. Yellow.	No A.-I.		A.-I. Green.	A.-I. Yellow.	No A.-I.
Seen as Violet.	3		2	1	8	8			4	4		
" " Blue.	9(1)		9	(1?)	21 (2)	7	13 (1)	1(1)	23(1)	13	5orange	3(1)2?
Not Seen.					2	1		1				
	Total No. Tests = 13.				Total No. Tests = 33.				Total No. Tests = 28.			
	After-image Green = 0.				After-image Green = 16.				After-image Green = 17.			
	" " Yellow = 11.				" " Yellow = 14.				" " Orange = 5.			
	No After-image = 2.				" " Not Seen = 4.				No After-image = 6.			

TABLE VII.

OBSERVER P.

Carmine.	Background No. 1.				Background No. 3.				Background No. 34.			
Color.		A.-I. Green.	A.-I. Yellow.	No A.-I.		A.-I. Green.	A.-I. Yellow.	No A.-I.		A.-I. Green.	A.-I. Yellow.	No A.-I.
Seen as Carmine.	6	2	3(1 red)		20	15	5		14	6	1	7
" " Violet.					8(1)	1(1)	7		2			2
" " Blue.					2		2		7			7
Not Seen.	4			4	15		5	10	4		2	2
Total No. Tests = 10.					Total No. Tests = 46.				Total No. Tests = 27.			
After-image Green = 2.					After-image Green = 17.				After-image Green = 6.			
" " Yellow = 3.					" " Yellow = 19.				" " Yellow = 3.			
" " Not Seen = 4.					No After-image = 10.				No After-image = 18.			

TABLE VIII.

OBSERVER H.

Carmine.	Background No. 1.				Background No. 3.				Background No. 34.			
Color.		A.-I. Green.	A.-I. Yellow.	No A.-I.		A.-I. Green.	A.-I. Yellow.	No A.-I.		A.-I. Green.	A.-I. Yellow.	No A.-I.
Seen as Carmine.	10(1)	3 1?		6(1)	19(9)	9		10(9)	17(1)	4		13(1)
Not Seen.	8			8	20			20	9			9
Total No. Tests = 19.					Total No. Tests = 48.				Total No. Tests = 27.			
After-image Green = 3.					After-image Green = 9.				After-image Green = 4.			
" " Yellow = 0.					" " Yellow = 0.				" " Yellow = 0.			
" " Not Seen = 16.					" " Not Seen = 39.				" " Not Seen = 23.			

TABLE IX.

OBSERVER F.

Carmine.	Background No. 1.				Background No. 3.				Background No. 34.			
Color.		A.-I. Green.	A.-I. Yellow.	No A.-I.		A.-I. Green.	A.-I. Yellow.	No A.-I.		A.-I. Green.	A.-I. Yellow.	No A.-I.
Seen as Carmine.	3(2)			3(2)	15(2)	10(1)		5(1)	17(4)	6	1?	10(4)
" " Blue.	2(3)	(1)		2(2)	5(1)	1(1?)	1	3	4(2)			4(2)
Not seen.	7(1)			7(1)	21(1)	1(1)	8(1 or)	11	2			2
Total No. Tests = 18.					Total No. Tests = 45.				Total No. Tests = 29.			
After-image Green = 1.					After-image Green = 14.				After-image Green = 6.			
" " Yellow = 0.					" " Yellow = 9.				" " Yellow = 0.			
No After-image = 17.					" " Orange = 1.				No After-image = 23.			
					No After-image = 21.							

TABLE X.

OBSERVER P.

Green-Blue.	Background No. 3.				Background No. 34.			
Color.		A.-I. Orange.	A.-I. Yellow.	No A.-I.		A.-I. Orange.	A.-I. Yellow.	No A.-I.
Seen as G.-B.	5	4	1		3	1 red		2
" " Blue.	10	1	9		11	7 red	2	2
Not Seen.	4		3	1				

Total No. Tests = 19.
After-image Orange = 5.
" " Yellow = 13.
No After-image = 1.

Total No. Tests = 14.
After-image Red = 8.
" " Yellow = 2.
No After-image = 4.

TABLE XI.

OBSERVER H.

Green-Blue.	Background No. 3.				Background No. 34.			
Color.		A.-I. Orange.	A.-I. Yellow.	No A.-I.		A.-I. Orange.	A.-I. Yellow.	No A.-I.
Seen as G.-B.	14	1	13		8	6 1 red	1	
" " Blue.	17(1)		15(1)	2	7(1)	3	2	2(1)
Not Seen.	7		2	5	2			2

Total No. Tests = 39.
After-image Orange = 1.
" " Yellow = 31.
No After-image = 7.

Total No. Tests = 18.
After-image Orange = 9 (1 red).
" " Yellow = 3.
No After-image = 5.

TABLE XII.

OBSERVER F.

Green-Blue.	Background No. 3.				Background No. 34.			
Color.		A.-I. Orange.	A.-I. Yellow.	No A.-I.		A.-I. Orange.	A.-I. Yellow.	No A.-I.
Seen as G.-B.	6	5	1		9	8		1
" " Blue.	13	3	7	3	12	3 2 red	1	6
Not Seen.	4		2	2	2			2

Total No. Tests = 23.
After-image Orange = 8.
" " Yellow = 10.
No After-image = 5.

Total No. Tests = 23.
After-image Orange = 11.
" " Red = 2.
" " Yellow = 1.
No After-image = 9.

TABLE XIII.

OBSERVER H. TEMPORAL MERIDIAN. BACKGROUND NO. 3.

Stimulus.	Color Seen.	20°.	25°.	30°.	35°.	37.5°.	40°.	45°.	47.5°.	50°.	52.5°.
Violet.	Violet.						1*y*			III IV *y*	
"	Blue.	1*g* 1*y*		2*y*	2*y*	3*y*	3*y*	(1) 1*y*	1 *y*		
Carmine.	Carmine.	3*g*	2*g* 1	1*g*	II	II*g*	1*g* III	II			
"	Violet.			1*y*	1*g*						
Yellow.	Yellow.						2*b*	6*b*	2*b* 1	3*b*	VI
Blue.	Blue.		1*y*		1*y*		3*y*	3*y*	3*y* 2I	I III *y* II 1*y*	IV 1*y*
Black.	Black.				I		I	2	2	5	2
Gray No. 3.	Gray.						I	4	I	I	I

TABLE XIV.

OBSERVER C. NASAL MERIDIAN.

Stimulus.	Color Seen.	Back-ground.	92.5.°	94°.	95.5°.	97°.	98.5°.	99.5°.	101°.
Blue.	Blue.	No. 34	2	2*y* 10 1	5 I	II I*y* 5	3*y* 3 II (2)	IV I*y* 1*y* (2)	VI I*y* 4
"	"	No. 3	1*y* 1	2*y*	II 1 3*y*	I I*y* 3*y* 1	II I*y* 3 2*y*	II*y* II 2*y* 1	II III*y* 1
Yellow.	Yellow.	No. 3	2*b*	1*b* I*b*	2*b* 3	I II*b* 2 1*b*	4*b* 1 (1)	I*b* (3) 2	IV 3
"	"	No. 34	1 1*b*	5*b*	3*b* I*b* 1	4 3*b* (1) I	6 2*b* I	III 6 (1) 5*b* I*b*	VI 5 (2) 1*b*

EXPLANATION OF TABLES.

The Arabic numerals designate the number of times the stimulus was seen in a given color-tone; the Roman numerals the number of times the stimulus appeared colorless. In cases in which the judgment was doubtful the number is enclosed in brackets. In Tables IV. to XII. the numbers are inclosed in brackets when the observer was doubtful concerning the tone of the stimulus color, a question mark is placed beside the number when the observer was in doubt concerning the tone of the after-image.

The suffix in Tables I., II., III., XIII. and XIV. designates the tone of the after-image in each case: *y* = yellow, *g* = green, *o* = orange, *r* = red and *b* = blue. For example 3*y* means that the color was followed 3 times by a yellow after-image.

The backgrounds are Hering gray, Nos. 1, 3 and 34, and the stimuli fully saturated Hering colors.

THE DOCTRINE OF PRIMARY AND SECONDARY SENSORY ELEMENTS. (I[1]).

BY DR. BORIS SIDIS,
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I.

The theory of perception is fundamental both in normal and abnormal psychology. All mental activities are intimately related with the process of perception. Our wills, our thoughts and our feelings relate to our experience of the outer world of things. Biologically regarded, the percept is of the most vital importance, inasmuch as it forms the medium between the individual and the outer environment; psychologically, the percept reflects the external world and mirrors the conditions of life to which the given organism has to adjust itself. In fact, the percept may be regarded as the coin possessing the value of the external environment. In this respect we cannot help agreeing with Professor Baldwin's statement: "The theory of perception is perhaps the most important as well as the most difficult problem in psychology. The interpretation of the higher processes of mind rests upon it and it underlies the body of our general philosophy. The great philosophies of the world take their rise from initial differences in the method of construing perception."

In abnormal psychology the theory of perception is of the utmost importance, both from a theoretical and practical standpoint. Illusions, hallucinations, dream states, subconscious states, many states of dissociation depend for their explanation on the analysis of the process of perception. In one of my papers on hallucinations, published in this REVIEW, I have developed a theory of perception, a theory which may be characterized as *the doctrine of primary and secondary sensory elements*. This doctrine is based on a close analysis of the

[1] The MS. of this article was received November 1, 1907. — Ed.

normal process of perception and is substantiated by observations and experiments of abnormal mental life.

Before however we state our view of perception it may be well to make a review of what the principal psychological authorities teach on the subject.

James Mill in discussing perception tells us: "The colors upon a body are different, according to its figure, its shape, and its size. But the sensations of color and the sensations of extension, of figure, of distance have been so often united, felt in conjunction that the sensations of the color are never experienced without raising the ideas of the extension, the figure, the distance in such intimate union with it, that they not only cannot be separated, but are *actually supposed to be seen* (italics are mine). The sight, as it is called of figure, or distance, appearing, as it does a simple sensation, is in reality a complex state of consciousness a sequence in which the antecedent, a sensation of color, and the consequent a number of ideas are so closely combined by association that they appear not one idea, but one sensation."

Sully defines perception as a mental act that 'supplements a sense impression by an accompaniment or escort of revived sensations, the whole aggregate of actual and revived sensations being solidified or integrated into the form of a percept.' The revived sensations are equivalent to James Mill's associated ideas and images. We shall point out later the confusion which generally prevails among psychologists and psychiatrists, when they talk indiscriminately of revived sensations and ideas regarding the two as identical.

Höffding describes the process of perception "as the fusing of a reproduction and an actual sensation. The percept is thus conceived as compounded out of a representation and a sensation."

Taine tells us that "Images associated with the sensations of the different senses, especially with those of sight and touch constitute acquired perceptions."

Wundt regards the percept as a psychical compound of ideas or of revived sensations or images. In that respect his analysis differs but little from that of other psychologists who regard

the ideas, images and revived sensations as identical elements going to form the associated whole or psychic compound, the percept.

Külpe speaks of 'centrally excited sensations' regarding them as the ideas and the images of the psychologists and psychiatrists and tells us that he avoids the use of 'ideas.' As far as perception is concerned he closely follows his master Wundt and talks of psychic compounds, of sensations and centrally excited sensations which really are identical with the old fashioned ideas and images.

Titchener follows closely Wundt and Külpe and regards the 'percept as a compound, or a complex of sensations,' of peripheral and of centrally initiated sensations. In order to be explicit he hastens to tell us that there is no fundamental difference between the perception and idea. "It is customary to speak of perception, when the majority of the simple processes in the complex are the result of stimulation of a sense organ, *i. e.*, are peripherally aroused, and of idea when the greater number are the result of an excitation within the brain cortex, *i. e.*, are centrally aroused. If I have a table before me and my eyes open I am said to perceive the table; if I close my eyes and think of what I saw, to have an idea of a table. But we have seen that the sensations aroused centrally do not differ as psychological processes from those aroused peripherally." This statement put in such an explicit form brings out clearly what may be designated as the psychologist's fallacy. The fallacy becomes specially apparent in the domain of abnormal psychology.

Baldwin with his characteristic breadth of comprehension puts the subject of perception on a wide basis: "Perception is the apperceptive or synthetic activity of mind whereby the data of sensation take on the forms of representation in space and time; or it is the process of the construction of our representation of the external world." Baldwin does not commit himself to the ordinary fallacy current among psychologists.

Similarly James with his genius for psychological insight tells us: "The consciousness of particular material things present to sense is nowadays called perception." And again

"Perception thus differs from sensation by the consciousness of farther facts associated with the object of the sensation." He tells us further: "We certainly ought not to say what usually is said by psychologists and treat the perception as a sum of distinct psychic entities, the present sensation namely, plus a lot of images from the past, all integrated together in a way impossible to describe. The perception is one state of mind."

We thus see that most of the psychologists regard the percept somewhat in Spencerian terms as being made up of presentations and representations, or as Spencer puts it as being 'partly presentative and partly representative.' In other words the percept is a compound of sensations and images, a synthesis of peripherally induced sensations and of images, or of ideas centrally excited. One principle underlies the current theory of perception, variously phrased by different psychologists, and that is the identification of ideational and sensory processes.

The identification of ideational and sensory processes may be traced to Spinoza when he tells us in his *Ethics*, Prop. XVII., note, "The modifications of the human body, of which the ideas represent external bodies as present to us, we will call the images of things" and then in another place of Part II., Prop. XLIX., note, "In order to illustrate the point let us suppose a boy imagining a horse and perceiviug nothing else. Inasmuch as this imagination involves the existence of the horse, and the boy does not perceive anything which would exclude the existence of the horse he will necessarily regard the horse as present; he will not be able to doubt its existence, although he be not certain thereof. We have daily experience of such a state of things in dreams." The images, according to Spinoza, are equivalent to sensations and percepts, unless counteracted by the more intense peripheral sensations which thus become the 'reductives' of the image, a doctrine afterwards fully developed by Taine. I may add that Spinoza's view of dreams is repeated almost verbatim by the greatest psychological authorities, all uncritically giving their assent to the current fallacy that the image is but a weakened sensation and that the sensation is an intensified image.[1]

[1] In my experimental work on sleep and dreams, soon to be published, I take up the subject in detail.

This theory of images and perception is perpetuated through Hobbes, Locke, Hartley, Hume, James Mill down to our times.

Hobbes in his terse English puts it: "Imagination therefore is nothing but decaying sense and is found in men and many other living beings, as well in sleeping as waking."

Locke derives his 'ideas' from 'experience,' but his 'experience' is somewhat vague and broad, inasmuch as it flows from two fountain heads, — sensation and reflection. "Let us then suppose the mind to be as we say white paper void of all characters without any ideas, how comes it to be furnished? . . . To this I answer in one word from experience. . . . Our observation employed either about external sensible objects or about the internal operations of our minds, perceived and reflected on by ourselves is that which supplies our understanding with all the materials of thinking. These two are the fountains of knowledge from whence all the ideas we have or can naturally have, do spring." Perception is used by Locke in a broader sense than what it is understood at present, as he uses perception for sensory experience as well as for the introspection of higher mental processes. He tells us, however, that in either case "the mind has a power to revive perceptions which it has once had, with this additional perception annexed to them that it has had them before." Locke evidently entertains the view that sensations can be revived as original sensory experience and that the revived ideas do not differ, except for the addition of pastness, from the original ideas derived from the great source of sensation.

When we pass to Hartley and Hume the identification of sensation and idea is set forth with great explicitness. In fact, it is taken as the fundamental principle of their psychological systems. Thus Hartley postulates in his eighth proposition that "Sensations by being often repeated leave certain vestiges, types or images of themselves which may be called simple ideas of sensation" and correspondingly we have that "sensory vibrations by being often repeated beget in the medullary substance of the brain a disposition to diminutive vibrations which may be called vibratiuncles and miniatures corresponding to themselves

respectively." The vibratiuncle is the physical substratum of what we experience as an idea and is a copy of the original vibration. The vibratiuncle is a weakened vibration and the idea is a weakened sensation.

Hume does not burden himself with Hartley's vibrations and vibratiuncles, but still at the basis of his system we find the same fallacious psychological principle. "All our ideas" he says "are copies of our lively perceptions or impressions." In other words, our sensations are lively impressions, while the ideas are only weakened perceptions, — the idea differs from the sensation only in intensity. There is no qualitative difference between sensation and idea. Ideas belong to sensory processes and do not differ as such from sensations. This view has since become the heritage of current psychological theories.

II.

As in many other sciences, especially the ones of the purely mental variety, a good deal in psychology is traditional such for instance are the tripartite and bipartite division of the mind or the various classifications of the mental activities. Of course, classifications as well as theories have their important function in science, but they should not be permitted to become a bed of Procrustes to the guests whom they shelter.

It may sometimes be well to disregard established principles, classifications and time-honored traditions and study the facts from a somewhat different standpoint. We may then possibly see the facts in a new light and realize aspects and connections which are hidden from the customary view of the phenomena.

Suppose we take a mental cross-section of a moment of perceptual consciousness in the very act of formation of a percept. The whole perceptual moment may be said to be spread out before our mental gaze. We find sensory elements of a relatively intense character. Certain sensory elements stand out first and foremost in consciousness, they are the very first to arrest the mental gaze and keep it steadily fixed on themselves. In the same view however we can also discern other elements, not so prominent, though equally sensory which, on account of their

lack of prominence, appear to be of a subordinate character. The whole tone of the percept is given by the qualitative aspect of the prominent elements which seem to guide and form the organization of the percept.

The general plan of the structure of the percept may be compared to that of the cell. A close examination of the cell reveals the presence of a central element, of a nucleus surrounded by cytoplasm with its meshwork, the cytoreticulum. The nucleus forms the central and important structure having the functions of assimilation and reproduction. The nucleus and cytoplasm however are intimately related; the modification of one affects the other. Both nuclear and cytoplasmic structures form one organized whole, one living cell. Similarly in the percept we find a group of sensory elements which constitute the nucleus and a mass of other sensory elements, possibly the main mass, forming the tissue of the percept. The nuclear elements are more intense and appear to be predominant in the total mental state, — both however are intimately connected and go to form the living tissue of the percept. The nuclear elements of the percept have the lead and seem to possess the organizing, the fermenting power to assimilate the mass of subordinate elements and have them transformed into one unified organic whole. The slightest modification in the structure and function of the nuclear elements brings about a change in the total cytoplasmic mass of the percept, giving rise to a different structure, to a different percept; and again, modifications of the cytoplasmic mass, so to say, affect the formation of the nuclear elements often resulting in a different percept. It requires however quite a considerable change in the subordinate elements to bring about a change in the percept; while the slightest modification of the nuclear elements, whether in quality or intensity, will often bring about a fundamental transformation of the percept. The nuclear elements may be regarded as the sensitive, as the vital point of the perceptual system. We cannot displace nor can we modify the nucleus of the percept without profoundly modifying or even completely destroying the life existence of the percept.

We may point out here a very important aspect of the percept,

an aspect which has been neglected by the older psychologists, but which is now being more and more emphasized by the younger psychologists who lay more stress on the functional and biological side of mental life. Like the life of all organized beings, the life existence of every psychic state is for some reaction, for some adjustments to the conditions of the external environment. In the struggle for existence the animal organism must on pain of death be adjusted to the objects of its external world. Now the central, nuclear, sensory elements awakened by external excitations give the cue for the reaction, they form the sensitive organization for the release of motor energy in definite directions, they signify a definite object to which correspond definite motor tendencies with final reactions of adjustment. To the mouse the cat is not an object of contemplation or an object of observation, on account of its sensory effects, — the cat is an object to run away from. To the dog a cat is not an object of beauty, but something to be run after. The sensory stimulations coming from the 'that' which is mouse is for the cat something to be on the alert, to jump after and to attack. In fact the lower we descend in the scale of animal life, the more prominent do the motor reactions become. Where life is predominantly of the instinctive type, the motor side of consciousness is more apparent. The fly attracted by the scent to deposit its eggs in decomposed meat; the wasp that strikes the caterpillar in definite places paralyzing its nervous system, thus preparing food for the coming larva; the newborn infant starting to suck, when put to the breast — are good examples of motor reactions in response to sensory stimulations coming from external objects. A definite sensory stimulus is the trigger which releases a definite set of motor reactions. The fly, the bee is hardly conscious of the sensory characters of the honey; it is more likely that the sensory stimulations of the honey release the appropriate reaction of flying towards it. The bright colors of flowers developed in the course of natural selection for the fertilization of plants serve the same purpose; they awaken definite responses useful both to plant and insect, as it is hardly probable that the insects are primarily attracted by the beautiful coloring of the flowers. The visual stimuli awakening defi-

nite sensory elements may be regarded as central and nuclear which in turn serve as a highly sensitive trigger to release definite systems of motor reactions. The effect is somewhat similar to that of the moth attracted by the flame, — the flame acts as a peripheral stimulus giving rise to sensory elements which form the sensitive trigger in the release of the reaction of circling around the flame, in spite of the harmful results. The moth reacts to bright objects in going towards them, but this particular bright object, the flame, has not been provided for in the motor adjustments of the moth, hence the lack of adaptation, the going to the danger, instead of flying from it.

So apparently insignificant is the sensory side and so predominant is the motor side with its almost mechanically fatal reactions, that some physiologists put the whole mechanism of excitation and reaction in the lower animals under the category of tropisms, which may be positive or negative, according as the animal goes to or from the particular stimulus. The sensory side is denied, the whole affair is simply a delicate chemical reaction such as the chemotaxis of leucocytes in the phenomena of phagocytosis observed in inflammations and bacterial invasions, or what is still simpler as the phenomena of heliotropism observed in the case of plants. This purely mechanical or chemico-physiological view may be crude and far fetched in the case of lower animals, but it brings out strongly the predominance of the motor reaction in response to definite sensory excitations. The motor attitude of the animal towards the excitations of the external environment constitutes the predominant part of its objective world. The reactions with their sensory-motor effects are part and parcel of the total percept. Sensori-motor life gives reality to the world of objects. The spatial, the resistant, the material character of objects depends on our motor reactions which give content and reality to the world of things. Activity gives the sense of 'physical' reality, the sense of material actuality, or of what is regarded as 'the really real.' In other words sensory-motor reactions with consequent kinæsthetic sensations may be regarded as constituting the very essence of the real, external, material world, — the world of external, material objects.

III.

The percept as we have pointed out forms one organic whole, the constituent elements are firmly integrated into one living organization. In other words, just as the organism is not simply an integrated compound of cells, tissues and organs, but all those lower units go to form the higher living unit, the life of the organism as a whole, so we may say that the sensory elements are not the same as the percept, they are analytically found, on the autopsy of the percept, — the sensory elements are the lower units that help to form the higher unit, the living percept. From a scientific standpoint, as the resuit of psychological analytical dissection, the sensory elements going to make up the psychic compound, the percept may be regarded as different from the total synthesis with its characteristic living activity and its peculiar form of perceptual consciousness.

The constituent elements of the percept are not of the same definiteness and intensity. The central nuclear elements stand out more distinct, more definite and consciouness lights them up with more power and intensity. They are like the mountain peaks — when glade and valley and mountain side are still immersed in darkness, the rising sun greets the mountain tops and plays and caresses them with its rays; when again the shades of evening begin to flit and gather over vale, ravine and gulch, the rays of the setting sun long linger on the peaks taking of them their last farewell. The central nuclear elements are in the focus of consciousness, — they are the first to be met by the glance of the mental eye and are the very last to be left by it. Consciousness plays with its search-light on the nuclear sensory elements. The central nuclear elements are intense, distinct and definite, while the subordinate elements are of far less intensity, are often quite indistinct, are, so to say, on the fringe of consciousness; in fact, may even be entirely subconscious. And still indefinite, indistinct and submerged as those subordinate elements are, they form the main content of the percept, giving it the fullness of reality.

The nuclear elements form the cue of the total reaction, thus standing for the particular object, forming the reality of the percept for the organism. No wonder then that the cue,

though it may be the smallest portion of the percept, none the less forms for the organism the most vital, the most significant as well as the most constant part of the percept. The attitude, the total reaction of the organism depends on the slightest difference in the cue, on the slightest change of the nuclear elements, since the apparently slight modification may often prove of great significance to the life existence of the organism, — it may be a matter of life and death. The nuclear elements constitute the signal, the sensitive trigger for the release of definite reactions towards the changes of external objects. Hence the nuclear elements come to signify, in fact, to constitute the essence of the percept.

A change of the subordinate elements of the percept does not matter so much as the slightest modification in the quality or even in the intensity of the signal. This, of course, does not mean that the subordinate sensory elements are not psychologically and biologically of the utmost consequence to the organism, but they are not of that immediate importance as the focal nuclear elements appear to the consciousness of the organism. The nuclear elements as signal focus the interest of the animal. We can well realize their vital importance, if we consider that the nuclear elements are the flag which indicates friend or enemy, war or peace, life or death.

IV.

If we regard the percept statically, we may describe it figuratively as a psychic compound, the union of the elements having somewhat the character of a chemical combination. A new compound is formed possessing qualities of its own, different from those of the constituent elements. The sensory characteristics are profoundly modified in the synthesis, so much so that they cannot be directly discerned and can only be discovered by patient analysis. The elements do not exist freely, they are bound up in one indissoluble union of the percept. It seems, as if different qualitative states arise in the union, the qualities of the elements appearing, as if transformed by the effected synthesis.

The percept forms a new compound in which the component

elements are disguised and transformed by the qualitative aspect of the central elements. The subordinate elements become adapted to the active nucleus and come out in the compound with sensory characteristics foreign to their nature. In the process of synthesis the subordinate elements become transmuted and assume the sensory characteristics of the nucleus. To analyze the various elements out of the synthetized percept, the central elements must be shifted, — the subordinate elements must be made focal, giving rise to new percepts, but at the same time making it possible to pass in review the various elements. In other words, the elements become revealed in proportion as we make of them signals, in proportion as they become significant of the total percept with its sensori-motor reactions.

The nuclear elements are the most pronounced, the most prominent, as far as saturation of sensory quality is concerned. They have so much of their peculiar sensory quality that they diffuse it into the other elements, — the subordinate elements appear under the sensory form of the nucleus; they become assimilated by the nucleus and are saturated with its sensory coloring. This holds true not only in regard to saturation, but also in regard to sensory brightness. The central elements possess a sensory brightness far in excess of other elements and hence they shed their sensory light on the more obscure, though no less important sensory elements. What however they illumine is not so much the peculiar sensory characteristics of those elements, but their own coloring with which they have saturated the total percept.

The force of the central elements lies specially in the emotional or affective tone with which they are pervaded. They arouse an attitude towards the external world in general and to the special object in particular, Taine would call it a tendency. The individual is stimulated by those nuclear elements and his whole attention is going out in direction to the object that has excited them. The whole organism is invaded by the subtle influence of the nucleus giving rise to definite sensori-motor reactions, intensifying the affective state which permeates the perceptual consciousness. The affective state of the percept is not always obvious in cases of fleeting percepts, but it becomes

manifest, when the central elements become temporarily fixed, the stress and strain of consciousness tending in one direction. The very changes occurring in the flickering intensity of the nuclear elements tend to sharpen the situation, to enliven the interest, strain the attention and be all agog so to say. The cat getting a glimpse of a mouse, or the dog catching sight of the cat may be taken as good illustrations of the affective states present in perceptual consciousness. The nuclear elements are the ones that are specially charged with affective or emotional states.

Biologically regarded, we can well see the importance of the central nuclear elements, the necessity of their standing out in consciousness as more prominent and more intense than the rest of the sensory elements. Constituting the signal, they come to be the most significant part of the percept, for they announce what 'that' is, they present the object, friend or foe, something to welcome or something to flee from. The central nuclear elements thus come to present objective reality, they safeguard the individual, they are the safety as well as danger signal. The more delicately differentiated those safety-danger signals are, the more protected the individual is in the struggle for existence. The more sensitive the individual becomes to the least difference of the nuclear elements, the better adjusted will he be to the conditions of the external environment and the better will be his chances in the process of survival of the fittest.

This brings us to the purposiveness of the percept. One of the important characteristics of the biological process is the final cause, the purpose which leads to the preservation of that process, to the preservation of the individual. We should therefore expect that in the psychic process which is the most highly developed biological process, purposiveness will be one of the most important traits. In the course of phylogenetic and ontogenetic evolution some sensory elements, the ones to which the organism is more sensitive, will be selected and become the indicators of the total percept, they will become the index or better to say the pain-pleasure flag, the safety-danger signal. The central elements will thus be the most prominent, the most intense for that particular state of perceptual consciousness. The

nature and character of the elements will vary with the organizations of the species and the individual. The dog will become more sensitive to variations of his olfactory sensations, while man will show marked sensitivity towards delicate differences of his visual sensory elements.

The great sensitivity of the nuclear elements is significant in so far as they lead to better adaptation and to more successful reactions. It is not of any consequence for the cow to gaze at the stars, for the pig to observe the phases of the moon, but it is a matter of importance for them to perceive any signs of food or the approach of a beast of prey. The heavenly bodies are non-existent for the brutes, because of lack of all reactions of adaptation, while food and predatory beasts are easily detected, because of the vital reactions bound up in the elements of the percept of which the nuclear elements form the signal. It is on account of the vital reactions that the perceptual nucleus plays such a prominent part and takes the lead of all the other elements. As I have pointed out in a former paper: "Every psychic state is for some reaction and that sensory element which gives the cue for the formation of the psychomotor elements, leading to some given reaction is, for the time being, the center, the nucleus of the total state."

V.

If we inspect the percept more closely, we find that there is some important difference in the character of the various constituent sensory elements. The central elements forming the nucleus of the percept are given *directly* by the sense-organ stimulated by its appropriate sensory stimuli, while the subordinate sensory elements are given *indirectly*, — they cannot be traced to appropriate sensory stimuli exciting those particular sense-organs on the activity of which those subordinate elements depend for their manifestation. In perceiving the lump of ice I can see the color, the size, the volume, the smoothness, the transparency, the distance and even the weight and coldness. Now what I can see directly is only the color, transparency, size, as given immediately by the stimulated sense-organ, by the visual sensations and image on the retina. Whence then come the

rest of the sensory elements so distinctly experienced? They are not memory images, — they have the same sensory characters as the elements given by the direct impression of the sense-organs. It is not that on perceiving a certain transparent object we remember its volume, its distance, its smoothness, its resistance, we perceive all that in sensory terms. They are not images, ideas, or representations — they are sensations. The central sensory elements may be termed direct or *primary*, while the subordinate elements may be termed indirect or *secondary*. The percept then may be regarded as consisting of two classes of elements of sensations, the primary and secondary sensory elements.[1]

The secondary sensory elements are not images, nor ideas, nor representations, different terms employed for the same state by various writers, the secondary elements of the percept are essentially sensations. Now sensations are qualitatively different from images, ideas or representations. The image of a light does not shine, the idea of a voice does not sound and the representation of a perfume does not smell. A sensation or presentation as it is sometimes termed differs from an image or representation qualitatively, fundamentally. The sensation or presentation is given as immediate experience, while the image, the representation is essentially mediate, it is a mental substitute for the immediate experience of the sensation. The idea bears the same relation to the sensation as the photograph bears to the original, or rather as a symbol to the thing it represents. Ideas, images, representations symbolize sensations, but they are not sensations. A sensory process is fundamentally different. A sensation is not an intense idea, nor is an idea a weak sensation. Ideas differ far more qualitatively from sensations than visual sensations, for instance, differ from olfactory sensations. There is not a particle of evidence to substantiate the view that ideas or images are copies of sensations in the sense of being weak sensations or 'centrally excited sensations.' There is nothing of the sensory in the idea. The weakest sensation cannot compare

[1] It may be well here to point out that the doctrine of primary and secondary sensory elements advanced by me has nothing in common with the primary and secondary qualities of the older psychologists.

with the most vivid representation. The laboratory experiments on that subject (Münsterberg and Külpe) are inconclusive as they either deal with incompletely perceived impressions, or with minimal sensations. In either case the percept is incomplete and uncertain. Külpe himself is forced to admit that ideas or centrally excited sensations as he terms them "cannot be regarded as simple revivals of peripherally excited contents, if only for the reason, that their remaining attributes are very rarely indeed identical with those of perception." He then goes on making a fatal admission: "The most striking evidence of disparity is perhaps afforded by intensity. . . . It is only in special cases that centrally excited sensations can rise from their accustomed faintness to the vividness of sense perception. We then speak of them as hallucinations (?); and they enter into a disastrous competition with the real material of perception, completely transcending the boundary line which so usefully divides it from the material of imagination." Külpe admits that there is no intensity to the image, that there is no variation in 'intensity' of images, an 'attribute' characteristic of percepts. Psychologically regarded this in itself shows the qualitative difference between image and percept.

Ideational and perceptual processes cannot be identified. The two are qualitatively different: the sensation has intensity, the image lacks it. We shall discuss later on the main differences of sensation and image, meanwhile we may point out the differences in brief: (*a*) A sensation has intensity, an image totally lacks it; (*b*) the image is a reproduction or rather a representation, a symbol of a sensation, but no sensation represents another; a sensation unlike an image, is not mediate, but immediate experience; (*c*) a sensation bears the mark of externality, an image lacks it; finally (*d*) a sensation cannot be called up at will, while an image is independent of peripheral stimulations of external objects and is usually under the control of the will. No sensation differs so much from another as the image differs from its corresponding sensation.

To refer as Külpe does to a hallucination as an intensified image is to reason in a circle and at the same time to be in sad contradiction with facts. A hallucination may be regarded as

a fallacious percept, but it is not on that account an image; a hallucination is a percept and is essentially sensory in character. The fact of a percept being fallacious does not in the least imply that it is 'imaginary' and not sensory. The ambiguity of the word 'imaginary' has not a little contributed to the psychological fallacy helping towards the confusion of image and sensation. 'Imaginary' is used in the common sense meaning not corresponding to any external reality, or in the psychological sense of consisting of those internal events or processes known as images or ideas. Now 'imaginary' used in the sense of lack of an external object by no means implies the psychological sense of consisting of images. A hallucination is commonly said to be imaginary in the sense of not having an objective reality, but we have to prove yet that it consists of images. The theories of illusions, hallucinations as well as of dream states and hypnotic hallucinations are vitiated by that fundamental psychological fallacy. As a matter of fact hallucinations are not made up of images, but of sensory elements, while on the contrary hypnotic hallucinations are not made up of sensory elements, but of images. In a former paper of mine I have pointed out that hallucinations are not due to 'images' but to actual sensations, that, psychologically regarded, hallucinations do not differ in their make-up from ordinary percepts. Ideas and images are not possessed of magic virtues and with all the fancy work about them, they cannot display sensory qualities. The image or idea is that bloodless, shadowy, fluttering affair which can no more attain the life of a sensation than a written letter can attain the power of sound. Had it been otherwise the world would have been a large asylum for images to play their pranks in.[1]

[1] We may quote Stout as one of the few psychologists who seem not to accept the current psychological doctrine. In his 'Analytic Psychology' he tells us 'that complex perception does not consist in a given impression reviving a cluster of faint images of previous impressions.' And again "impressional revival does not in the least countenance the theory that ideas are merely faint revivals of impressions. On the contrary, it tends strongly in the opposite direction. It shows that a revived impression is itself an impression, and not an idea." In his 'Manual of Psychology' he says 'that at bottom the distinction between image and percept is based on a difference of quality.' And again, "percepts and images possess a relative independence. This can be accounted for, if we suppose that the nervous tracts excited in perceptual process are not wholly coincident with those excited in ideational process."

The elements of the percept are not ideational, not imaginary, they are essentially sensory. The perceptual elements are synthetized into one percept. To take our stock example, the ice. The lump of ice is experienced as one object with many qualities each of which furnishes respectively its sensory quota towards the formation of the whole of the perceptual experience. We see, we perceive the hard, heavy, smooth, resistant body of ice, — all the elements have alike the intensity of sensation. The hardness, the smoothness, the bodily resistance are perceived by the visual sense and are visual, but as such they of course differ from the sensations experienced by their appropriate sense organs, as when for instance the same sensations are given by touch or by muscular and kinæsthetic sensations. Those muscular and tacto-motor sensations appearing as visual are not memory-images, but they are actual sensations, they are *secondary* sensations; they are secondary sensory elements which give the fullness of content to the percept having visual sensory elements as its nucleus. Unlike memory-images, secondary perceptual elements have the immediacy of sensational experience. Remembered sensory qualities are not immediate experiences given in the object of perception.

If we turn to pathology, we find that cases closely confirm our view. In certain mental diseases the patient can perceive the various qualities, although he cannot represent them to himself. In other cases the patient can clearly and vividly represent objects in all their details, but he cannot perceive the objects, when directly confronted with them. Clinical cases, even if we exclude all facts from introspective analysis, clearly point to the qualitative difference of image and sensation irrespective of the assumption of localization, — they may be due to the function of different brain structures, or to different processes of the same brain structures. In the light of recent research it is more likely that the neuron structures underlying ideational processes differ from those subserving sensory processes. Whichever view however we entertain in regard to the anatomical structures all the facts go to prove that image and sensation are qualitatively different psychic events.

The percept is not ideational, but sensory. There are no

memory-images in perceptual consciousness, although the latter may be closely associated with ideational processes. Such ideas however are on the fringe of the perceptual consciousness and do not constitute the essence of the percept. The percept consists of sensory elements, primary and secondary. The primary elements are initiated directly by incoming peripheral stimulations, while the secondary sensory elements are brought about indirectly, through the mediacy of the primary elements, the secondary elements themselves being really derived from sense-organs others than the one directly stimulated by the peripheral excitation.

If the percept is visual and V stands for the visual physiological processes, A for the auditory, O for the olfactory, M muscular, K kinæsthetic, T for tactual physiological processes; then let V_1, M_1, O_1, K_1, T_1 stand for the primary sensory elements; and let V_2, O_2, M_2, K_2, T_2 stand for the secondary sensory elements, then the total percept may be represented by the formula $V_1O_2M_2K_2T_2$. Since all the other elements appear in the visual percept under the visual aspect we may represent the percept by the formula: $V_1M_2^{r_1}O_2^{r_1}K_2^{r_1}T_2^{r_1}$. The secondary sensory elements, though forming the main content of the percept, are apparently of a visual nature and still they really belong to qualitatively different realms of sensations. This clearly reveals their origin and nature: the secondary sensory elements are not visual, but they become so by being initiated through the visual sense. In other words, secondary sensory elements are not peripherally initiated. Are they then centrally excited sensations? No. They can only be induced by an external stimulus. But that external stimulus must act *indirectly*, through another sense-organ. In stimulating a sense-organ we not only get sensory elements characteristic of that particular sense, but also sensory elements belonging to other sense-organs which have not been stimulated. What really takes place is this: the external excitation acting on a particular sense-organ produces its appropriate sensations, but the peripheral physiological process diffuses or rather to say gets irradiated along other neurons of other sense structures, awakening their appropriate sensations Such sensations, not being directly,

but indirectly peripherally initiated should be regarded as secondary sensations.

VI.

The phenomena of secondary sensations are well known in psychological literature. Some psychologists following the general fallacy of confusing image and sensation describe vivid images succeeding sensations under the category of secondary sensations. Barring such confusion we may say that the pure phenomena of secondary sensations are essentially sensory in character. When a sensation due to the stimulation of a peripheral sense-organ, instead of being followed by a train of association of ideas is followed by another sensation belonging to the domain of another sense-organ, the phenomenon is known as that of synæsthesia or of the secondary sensations.

One image or representation relating to a sensation of one sense-organ may be associated and bring in its train of associations any other image relating to any other sensation of any other sense-organ. The series of ideas or images will be a reproduction of stimulated sense-organs with their accompanying sensations, the ideas running parallel to the original psycho-physiological processes, somewhat on the Spinozistic principle of '*Ordo et connexio idearum idem est ac ordo et connexio rerum.*' And again in other cases, when not reproducing a previous series of sensory experience, the series of associated images may be more irregular and apparently capricious — a process usually described as the work of fancy, or imagination. A sensation or image then may be followed by any series of images without the intermediacy of external excitations and peripheral physiological processes, but a sensation cannot be followed by a series of sensations without the intermediacy of external stimulations. A sensation can only be initiated by its own appropriate stimulus and by its own specialized peripheral physiological processes. The smell of a rose will not by simple association give rise to a series of sensations of touring in an automobile, nor will the eating of a beefsteak give rise, through association, to the hearing of a symphony. In other words, there is an internal association of images or ideas, but there is

not an internal association of sensations. Images once born can be reproduced endlessly and at will, sensations die almost immediately after they are born and must be renewed every time under the same conditions of external stimulations. Briefly stated, there is memory for images, but not for sensations. Sensations are independent, images are interconnected.

If we represent sensations by *A*, *B*, *C*, *D* and symbolize images by *a*, *b*, *c*, *d*, the *A*, *B*, *C*, *D* have no relations to one another, but each one bears a definite relation to each corresponding image, *A* to *a*, *B* to *b*, *C* to *c*, *D* to *d* and so with the rest of the series. Sensation *A* will arouse image *a* which in turn may arouse the whole train of images *b*, *c*, *d*, but *A* cannot give rise to any of the sensations *B*, *C*, *D*. The image series *a*, *b*, *c*, *d* can be reproduced at will, in fact after a series of repetition the whole chain of links may rattle off against will, but nothing of the kind occurs in the case of sensations. Sensations do not form links in a chain which becomes automatic after many reproductions. Repetition of sensations does not form associated series; sensations maintain their independence.

The difference between image and sensation in respect to association is, psychologically regarded, apparently flawless. Unfortunately as it is usually the case with flawless generalizations and descriptions of phenomena observed under normal conditions, there is an ungracious 'abnormal' that refuses to fall into line. There are cases apparently abnormal from the psychological standpoint, cases which refuse to be gathered into the normal psychological fold, the cases seem to run counter to all normal psychological introspection. The sensations seem to run riot, — instead of being linked with their respective images they really call up *associated* sensations, these are the so-called sound-photisms or light-phonisms and similar odd combinations. It is true the sensations are rather awkwardly associated. One sensation always calls forth only a particular sensation and no other one, and besides the called forth sensation does not belong qualitatively to the same domain with the one that has initiated it. It is also true that the sensations show their lack of sociable character by not entering into any association with any other sensation, and that unlike images no asso-

ciative series can possibly be formed. Still the fact remains that a sensation can and does call forth another sensation. Evidently sensations can enter into associative bonds. Such psychic states appear uncanny and are regarded as abnormal. The phenomena are regarded as freaks belonging to the domain of pathology. Now curiously enough our study reveals the fact that what has been regarded as the pathological and exceptional turns out to be the ordinary and the normal. The stone which the builders neglected has become the corner stone. The exception has turned out to be the rule. Far from being the case that secondary sensations are rare and abnorma , they are quite common, since they constitute the very flesh and blood of the percept. Secondary sensations constitute the texture of the percept. The reason why they appear so strange is just because they are so common and so familiar.

The secondary sensation, when appearing alone out of its perceptual complex, cannot be recognized as the old familiar attendant belonging to the indissoluble retinue of the humdrum percept. Dissociated from its perceptual sphere the secondary sensation appears ghostly, hallucinatory. As a matter of fact the secondary sensation, hallucinatory and spooky as its manifestations are, constitutes part and parcel of perceptual experience. In fact, the main content of the percept consists of hallucinatory secondary sensations. Percepts and hallucinations are of the same grain. A percept is a hallucination with the primary nuclear sensory elements *present*, a hallucination is a 'real' percept with the primary sensory elements *absent*.

When secondary sensory elements become dissociated from the perceptual synthesis with the primary sensory elements, the elements, thus dissociated, not being related to any peripheral physiological process of their appropriate sense-organ, are regarded as central phenomena, as secondary sensations which are described as unusual, abnormal events of mental life. What, however, is abnormal is not the secondary sensation *per se*, but the fact of its *dissociation*. A dissociated secondary sensory element becomes manifested as a secondary sensation.

VII.

Secondary sensations are free secondary sensory elements, dissociated from the perceptual aggregate into the synthetic unity of which they enter as important components forming the organic whole of the percept. When appearing isolated, secondary sensations are the simplest form of hallucinations which become more and more complex as the secondary sensory elements, dissociated from the primary elements, become manifested in complex systems. Hallucinations are systems of secondary sensations or of secondary sensory elements.

Sensory elements are, as a rule, not free, they usually appear as perceptual compounds, and this holds specially true of secondary sensory elements. When therefore dissociated from their perceptual compounds, they appear as ghosts of the 'real' percept, as hallucinations. To quote from a previous work of mine: "The integration of the groups and especially of the secondary presentative groups is not of that unmodifiable organic character. Around a nucleus formed by a group, or combinations of groups of primary elements, groups of secondary sensory elements become aggregated, and the total aggregate gives rise to a consolidated and unified system of groups, resulting in a percept. In perceiving the chair yonder only the visual sensations constitute the true sensory groups that form the nucleus of the percept. The other psychic groups that are crystallized round the percept, such as weight, resistance, volume, size, shape, distance are really visuo-tacto motor groups; they are largely tacto-muscular groups tinged by the sensory quality of the nucleus; they are tacto-motor groups sensorially visualized, seen indirectly. Though these secondary sensory groups are firmly integrated, still their integration is not of such a character as not to become disintegrated and rearranged into new systems of groups. Such a disintegration is no doubt effected with difficulty, but it is by no means impossible. The perceptual compounds, unlike the sensory, admit of decomposition into elementary primary and secondary sensory groups. The component elementary sensory groups can be experienced separately under different conditions and circumstances. We can close our eyes and walk up to the object of perception, say the chair,

and thus experience the free muscular sensations of distance, or we may push our hand against the chair and experience the sensation of resistance, or take the chair in the hand and experience the sensation of resistance, or take the chair in the hand and experience the muscular sensations of weight and shape. The primary and secondary groups going to make up the percept can be isolated by withdrawing the organizing nuclear group of primary sensations, thus bringing about a disintegration of the particular aggregate.

"If we inspect more closely this process of isolation, we find that the constituent secondary sensory groups are not really isolated, so as to stand out all by themselves. What actually happens in this seeming process of isolation is simply the formation of a series of new perceptual aggregates in which the particular sensory groups that are isolated and specially brought out become the nuclei, the foci. For in the perceptual aggregate it is always the character of the nucleus that is specially brought out, and it is the nuclear aggregate that tinges with its sensory color all the other aggregates. To revert to our previous example, to the percept-chair. In passing the finger over the chair, the touch may form the nucleus of the moment, but around this primary nuclear sensory group other secondary sensory groups, such as thermal and muscular sensory elements become organized to form the synthesis of the perceptual moment. If we try to find out the shape of the chair by a series of touches, we really form a series of percepts, the sensory nuclei of which are not visual, but tacto-muscular in their nature. A sensory group then cannot in reality appear in a purely isolated form." In other words, sensory elements appear in groups,[1] and this holds specially true of secondary sensory elements or of secondary sensations. Secondary sensations, though present in every percept, rarely appear in isolation. The affinity of secondary sensory elements to run into compounds becoming synthetized with primary elements makes it

[1] James lays stress on this fact of grouping of sensory elements: "*All brain processes are such as give rise to what we may call Figured Consciousness.* If parts are irradiated at all, they are irradiated in consistent systems and occasion thoughts of definite objects, not mere hodge-podge of elements."

difficult to observe them, except in the peculiar phenomena of synæsthesia and in the abnormal states of hallucination.

If secondary sensations are simple hallucinations, hallucinations are compound secondary sensations. As we have pointed out in a previous paper on hallucinations, a close examination of hallucinations shows them to be cases of systems of secondary sensations dissociated from their primary nuclear elements. In states of dissociation a peripheral stimulation with its physiological processes and concomitant primary sensory elements may become dissociated from systems of secondary sensory elements which alone stand out in consciousness as hallucinations. A close examination reveals the presence of some obscure pathological conditions which by irritation and by irradiation awaken secondary sensory elements givnig rise to full fledged hallucinations.